UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 E. LAMAR BLVD
ARLINGTON TX 76011-4511

October 30, 2015

Mr. Fadi Diya, Senior Vice President
and Chief Nuclear Officer
Union Electric Company
P.O. Box 620
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT - INSPECTION OF THE INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) - INSPECTION REPORT 05000483/2015008 AND 07201045/2015001

Dear Mr. Diya:

A team inspection was conducted of your Independent Spent Fuel Storage Installation (ISFSI) between May 19, 2015 and September 1, 2015. The purpose of the inspections were to observe your dry fuel storage preoperational testing activities, to independently assess your readiness to load spent fuel into the ISFSI, and to inspect your initial fuel loading operations. The inspections consisted of six separate inspection trips involving multiple inspectors to observe your dry fuel storage preoperational testing and loading activities. The initial loading of the spent fuel into the first dry fuel storage cask occurred between August 24 - September 1, 2015. The results of the inspections were discussed in an exit with Mr. Mark McLachlan, Senior Director of Engineering and other members of your staff on September 17, 2015.

During the inspections, the NRC staff examined activities conducted under your license as they relate to public health and safety to confirm compliance with the Commission's rules and regulations, and the conditions of your license. Within these areas, the inspection consisted of selected examination of procedures, representative records, observations of activities, and interviews with personnel. The enclosed report presents the results of these inspections. The inspection determined that you had completed all required activities identified in the Holtec Certificate of Compliance #1040 for use of the Holtec HI-STORM UMAX storage system at your site. No violations of significance were identified and no response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response if you choose to provide one, will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

To the extent possible, your response should not include any personal, privacy or proprietary information so that it can be made available to the public without redaction.

Should you have any questions concerning this inspection, please contact the undersigned at (817) 200-1191 or Mr. Lee Brookhart at (817) 200-1549.

Sincerely,

/RA/

Ray L. Kellar, P.E., Chief
Repository & Spent Fuel Safety Branch
Division of Nuclear Materials Safety

Dockets: 50-483; 72-104550
License: NPF-30

Enclosure:
Inspection Report 0500483/2015008,
07201045/2015001
w/Attachment: Supplemental Information,
Inspector Notes

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ADAMS ACCESSION NUMBER: ML15303A348

☒ SUNSI Review By: L.Brookhart		ADAMS ☒ Yes ☐ No		☒ Publicly Available ☐ Non-Publicly Available	☒ Non-Sensitive ☐ Sensitive
OFFICE	RIV/DNMS/RSFS	RIV/DNMS/RSFS	RIV/DNMS/RSFS	NMSS/DSFM/RMB	NMSS/DSFM/IOB
NAME	LBrookhart	ESimpson	GSchlapper	CMorell	JTapp
SIGN	***/RA/***	***/RA/E-Brookhart***	***/RA/E-Brookhart***	***/RA/E-Brookhart***	***/RA/E-Brookhart***
DATE	10/29/15	10/29/15	10/29/15	10/29/15	10/29/15
OFFICE	NMSS/DSFM/IOB	RIV/DNMS/RSFS			
NAME	JWoodfield	RKellar			
SIGN	***/RA/E-Brookhart***	***/RA/***			
DATE	10/29/15	10/30/15			

OFFICIAL RECORD COPY

Letter to F. Diya from R. Kellar dated October 30, 2015

SUBJECT: CALLAWAY PLANT - INSPECTION OF THE INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) - INSPECTION REPORT 05000483/2015008 AND 07201045/2015001

DISTRIBUTION:
Regional Administrator (Marc.Dapas@nrc.gov)
Deputy Regional Administrator (Kriss.Kennedy@nrc.gov)
DNMS Director (Mark.Shaffer@nrc.gov)
DNMS Deputy Director (Linda.Howell@nrc.gov)
DRP Director (Troy.Pruett@nrc.gov)
DRP Deputy Director (Ryan.Lantz@nrc.gov)
Senior Resident Inspector (Thomas.Hartman@nrc.gov)
Resident Inspector (Michael.Langelier@nrc.gov)
CWY Administrative Assistant (Dawn.Yancey@nrc.gov)
Branch Chief, DRP/B (Nick.Taylor@nrc.gov)
Senior Project Engineer, DRP/B (David.Proulx@nrc.gov)
Project Engineer, DRP/B (Steven.Janicki@nrc.gov)
Project Engineer, DRP/B (Jan.Tice@nrc.gov)
DNMS Technical Assistant (Vivian.Campbell@nrc.gov)
RSFS Branch Chief (Ray.Kellar@nrc.gov)
RSFS Senior Inspector (Lee.Brookhart@nrc.gov)
RSFS Inspector (Eric.Simpson@nrc.gov)
RSFS Inspector (Gerald.Schlapper@nrc.gov)
NMSS Inspector (Clyde.Morell@nrc.gov)
NMSS Inspector (Jeremy.Tapp@nrc.gov)
NMSS Inspector (Jon.Woodfield@nrc.gov)
Project Manager, SFST (William.Allen@nrc.gov)
Public Affairs Officer (Victor.Dricks@nrc.gov)
Public Affairs Officer (Lara.Uselding@nrc.gov)
RITS Coordinator (Marisa.Herrera@nrc.gov)
TSB Technical Assistant (Loretta.Williams@nrc.gov)
Regional Counsel (Karla.Fuller@nrc.gov)
Congressional Affairs Officer (Jenny.Weil@nrc.gov)
Congressional Affairs Officer (Angel.Moreno@nrc.gov)
RIV/ETA: OEDO (Cindy.Rosales-Cooper@nrc.gov)
OEMail_Resources@nrc.gov
ROPreports

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Dockets:	50-483 and 72-1045
Licenses:	NPF-30
Report Nos.:	05000483/2015008 and 07201045/2015001
Licensee:	Union Electric Company
Facility:	Callaway Plant and Independent Spent Fuel Storage Installation (ISFSI)
Location:	Junction Highway CC and Highway O, Fulton, Missouri
Dates:	May 19 - 21, 2015, Welding Dry Run June 2 - 4, 2015, MPC Fluid Operations Dry Run June 16 - 18, 2015, MPC Lid to Shell Cutting Dry Run July 13 - 17, 2015, Program Reviews, Fuel Building to ISFSI Dry Run August 3 - 6, 2015, Inside Fuel Building Heavy Loads Dry Run August 24 - September 1, 2015, First Canister Loading Operations
Team Leader:	Lee Brookhart, Senior Inspector, RIV Repository and Spent Fuel Safety Branch
Inspectors:	Eric Simpson, ISFSI Inspector, RIV Gerald Schlapper, Decommissioning Inspector, RIV Clyde Morell, Storage & Transport Safety Inspector, NMSS Jeremy Tapp, Storage & Transport Safety Inspector, NMSS Jon Woodfield, Storage & Transport Safety Inspector, NMSS
Approved By:	Ray L. Kellar, P.E., Chief Repository & Spent Fuel Safety Branch Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

Callaway Plant and Independent Spent Fuel Storage Installation
NRC Inspection Report 50-483/2015-08 and 72-1045/2015-01

The NRC team conducted an extensive evaluation of Callaway's program for the safe handling and storage of spent fuel at their UMAX ISFSI, observed the pre-operational training demonstrations, and observed the loading of the first spent fuel cask system. The Callaway Plant had selected the Holtec Certificate of Compliance #1040, HI-STORM UMAX cask storage system for use at their site's Independent Spent Fuel Storage Installation (ISFSI). This system consisted of the Multi-Purpose Canisters (MPC-37) that store 37 pressurized water reactor fuel assemblies in a below grade Vertical Ventilated Module (VVM). Callaway had constructed the UMAX ISFSI to hold 48 MPC-37s within the VVMs at the site. The ISFSI location includes space to eventually expand the UMAX to accommodate an additional 96 VVMs, if the site feels that it will be required in the future. The ISFSI was licensed by the NRC under the general license provisions of 10 CFR Part 72, Subpart K. The licensee planned to load six canisters for placement within the UMAX ISFSI during fall of 2015, of which the first canister loading was observed by the NRC.

This inspection report covers six separate inspections conducted between May 19 and September 1, 2015. During the dry run demonstrations and loading activities the inspectors verified compliance with licensing documents: Holtec Certificate of Compliance No. 72-1040 and Technical Specifications, Amendment 0; the UMAX Final Safety Analysis Report (FSAR), Revision 2; the FW FSAR, Revision 3; the NRC's Safety Evaluation Report for 72-1040, Amendment 0. Callaway developed a pre-operational test plan which consisted of five dry run demonstrations encompassing the pre-operational testing and training exercises required by License Condition 8 of the Holtec Certificate of Compliance. The demonstrations were conducted under the observation of the NRC. Twenty- three technical areas were reviewed during the inspections including such topical areas as the overhead crane requirements, loading operations, fuel verification, radiological programs, quality assurance, heavy loads, training, welding, fire protection and others. Subsequent to the site visits, an extensive in-office review was performed of documents provided by the Callaway staff. This effort involved the review of licensee reports, procedures, calculations, training documents, test results, personnel qualification records, safety evaluations, and condition reports to support the conclusion that the licensee had developed and implemented a comprehensive program to support ISFSI activities.

During the inspections, the licensee completed the demonstrations related to the operations of equipment and the implementation of procedures to verify that all operations required by the technical specifications could be performed safely. The programs review conducted by a NRC team of six inspectors, concluded that the licensing requirements related to dry cask storage had been adequately incorporated into the site's programs and procedures. During the various pre-operational demonstrations and first loading, the Callaway workers demonstrated a comprehensive understanding of the technical requirements related to the loading and operations of an ISFSI. Callaway's first cask was placed within the site's UMAX ISFSI on September 1, 2015.

Details related to the technical areas reviewed during this inspection are provided as Attachment 2 "Callaway Inspector Notes" to this inspection report. The following provides a summary of the observations of this inspection.

Canister Drying/Inerting

- Forced helium dehydration dryness limits established in Technical Specification A.3.1.1.1 and Table 3-1 had been incorporated into the licensee's procedures. The licensee planned to use the forced helium dehydration system for drying all canisters loaded at the site. Operation of the forced helium dehydration system was demonstrated during the pre-operational dry run exercises.

- Helium backfill pressure requirements established in Technical Specification A.3.1.1.2 and Table 3-2 had been incorporated into the licensee's procedures.

Crane Design

- The licensee had evaluated their fuel building 125-ton crane against the criteria in NUREG 0554, ASME NOG-1, and CMAA Spec #70-2010 and found the crane to meet the criteria for a single failure proof crane.

- Specific aspects of the crane which included: the bridge and trolley brakes, main hoist safety devices, emergency stop features, crane two-block protection, and dual rope reeving system met the requirements of NUREG 0554 and NUREG 0612.

Crane Inspection

- The 125-ton fuel building crane was subjected to a daily inspection, performed prior to use, that satisfied the requirements of ASME B30.2, Section 2-2.1.2 "Frequent Inspection." On an annual basis the crane was subjected to a more rigorous inspection that met the requirements of ASME B30.2, Section 2-2.1.3 "Periodic Inspection."

- A performance test was completed at Callaway after the new 125-ton trolley and hoist were installed. The site test included hoist raising/lowering at all speeds, trolley travel in both directions at all speeds, bridge travel in both directions at all speeds, and testing of all safety devices.

- The crane's hook was inspected annually as required by ASME B30.10, Sections 10-1.4.2 through 10-1.4.6.

Crane Load Testing

- Callaway's new 125-ton crane's trolley and hoist were dynamically load tested to 100% of the rated load and statically loaded to 125% after installation within the fuel building in June 2014.

- The fuel building 125-ton crane utilized a 150-ton hook which was subjected to a 200% hook load test of 300 tons in February 2014.

Crane Operation

- The maximum weight the 125-ton crane would lift during the cask loading campaign was 123.5 tons when lifting the HI-TRAC VW transfer cask containing the MPC-37 canister loaded with spent fuel out of the spent fuel pool.

- Callaway's qualification requirements for crane operators were consistent with the requirements listed in ASME B30.2.

- The licensee had the ability to manually lower the load and manually move the bridge and trolley if an emergency occurred. These provisions had been incorporated into a licensee procedure.

- The licensee's procedures required brake checks and specified a minimum travel height when lifting the HI-TRAC VW.

Dry Run Demonstration

- The licensee successfully completed all the required pre-operational tests specified by License Condition #8 of the Certificate of Compliance. This included welding, drying, and backfilling of a mock-up canister and the simulated unloading of a sealed canister. A weighted canister was used to demonstrate heavy load activities inside the fuel building, transport between the fuel building and the UMAX ISFSI, and movement back into the fuel handling building for unloading purposes. Inside fuel building dry runs included placement of an empty MPC and HI-TRAC VW into the spent fuel pool and movement of a dummy fuel assembly into the MPC. Additionally, Holtec performed a dry run to demonstrate the removal of the canister lid welds, for unloading purposes, at Holtec Manufacturing Division (HMD).

Emergency Planning

- Emergency planning provisions for the ISFSI had been incorporated into the site-wide emergency plan. This included adding a specific emergency action level for an event damaging a loaded cask. Part 50 emergency action levels applicable to the ISFSI included fires, security threats, and events involving a radiological release from a canister.

Fire Protection

- A Fire Hazards Analysis had been performed specific to the Callaway UMAX ISFSI. Administrative controls were established to limit the quantity of combustible and flammable liquids around the ISFSI and near the transport path during movement of the canister.

- Site specific fire and explosion hazards had been evaluated to determine the effect on the UMAX ISFSI and to confirm that the location of the ISFSI, location of the transport route, and the design of the transportation equipment was adequate. Several nearby facilities were evaluated that included diesel tanks and pipes, lube oil tanks, gasoline tanks, hydrogen tanks, and delivery trucks of flammable liquids.

- Additional fire analysis was required for the use of the tracked vertical cask transporter (VCT), the low profile transporter (HI-PORT), and ancillary equipment to account for the fire loading due to all vehicles' fuel contents and their hydraulic fluids. Holtec provided calculations that showed the postulated fire involving all the equipment would not result in a significant increase in the temperature of the spent fuel inside a loaded canister when being transported.

Fuel Selection/Verification

- For the initial loading campaign, the licensee planned to load only intact fuel assemblies that met the requirements of Technical Specification Appendix B, Section 2.1, Section 2.3, and the associated tables. The fuel assemblies selected for the first canister met the limits for length, width, weight, irradiation cooling time, average burn-up, cladding, decay heat, and fuel enrichment.

- The licensee planned to load fuel in the canisters using the regionalized fuel loading concept allowed in Technical Specification Appendix B, Section 2.3 and Figure 2.3-1. For the initial loading campaign, the licensee selected the option to load cooler spent fuel into the outer canister locations to provide shielding to the hotter fuel assemblies that were placed in the inner locations of the canister.

- The licensee had established provisions for independent verification of the correct loading of spent fuel assemblies into the canister. This included use of an underwater camera to view the fuel assemblies' serial numbers.

General License Requirements

- The licensee evaluated the bounding environmental conditions specified in the Holtec FSAR and Certificate of Compliance No. 1040 Technical Specifications against the conditions at the site. This included: tornados, flood, seismic events, hurricanes/high winds, lightning, burial of the ISFSI under debris, snow/ice, normal and abnormal temperatures, and fires/explosions. The site environmental conditions at Callaway were bounded by the Holtec cask design parameters except for fire, explosions, and tornado driven missiles. Separate analyses showed that the site's ISFSI and dry cask storage transportation operations could withstand Callaway's site specific tornado driven missile, worst postulated fire event, and pressures due to an explosion.

- Projected radiation levels at the ISFSI were calculated for an assumed individual located at the owner controlled area boundary to determine the dose to this individual. The analysis assumed that the ISFSI was fully loaded with all 48 canisters in the UMAX ISFSI with fuel characteristics that bounded the UMAX design basis. The calculation concluded that the dose to any individual would be a small fraction of the regulatory limits. The calculated doses were well below the 10 CFR 72.104 limit of 25 mrem/year.

- The licensee performed an evaluation of the Part 50 reactor programs that could be impacted by the addition of an ISFSI. The evaluation included a review of the radiation protection program, emergency planning program, quality assurance program, training program, reactor technical specifications, and the Part 50 license. Revisions to the programs to incorporate the ISFSI were identified and implemented. None of the changes required an amendment to the plant's Part 50 operating license or technical specifications.

- The Holtec Certificate of Compliance and FSAR had been reviewed by the licensee to verify that the design basis for the Holtec system and the conditions and requirements in the Certificate of Compliance and FSAR were met.

- Callaway had developed procedures for controlling all work associated with cask handling, loading, movement, surveillance, maintenance, and testing. Procedures had been developed specific to the ISFSI activities. Numerous other procedures developed for the Part 50 reactor programs were being adequately applied to the ISFSI program.

Heavy Loads

- The licensee had incorporated the special requirements related to the ISFSI project into the site heavy loads programs and procedures. Crane operators interviewed were knowledgeable of the special handling requirements related to the spent fuel casks.

- Special lifting device height limits and temperature restrictions during movement of the canisters had been incorporated into the licensee's procedures consistent with the requirements in the Certificate of Compliance and FSAR.

- A safe loads path had been identified and analyzed for moving the spent fuel from the spent fuel pool. Provisions were established in procedures to prevent the crane operators from moving the loaded canister outside the boundaries of the safe load path while in the fuel building.

- The adequacy of the vertical cask transporter (VCT) for the expected weight of a loaded transfer cask and the ability of the transporter to safely perform downloading operations at the UMAX ISFSI was verified by NRC inspectors. The VCT was static load tested to 125% of its rated capacity and was given a 100% performance load test prior to fuel loading operations.

Loading Operations

- Requirements in the FSAR related to pre-operational inspections and annual maintenance of equipment were being implemented through the licensee's procedures.

- Technical specifications and FSAR requirements related to spent fuel boron concentration, fuel cladding not being exposed to air, handling of damaged fuel containers, and time-to-boil limits were implemented in the licensee's procedures.

- During the loading of the first canister beginning August 24, 2015, the NRC provided 24-hour coverage of the loading operations for all the critical tasks. This included fuel movement, heavy lifts of the loaded canister, radiation surveys of the loaded transfer cask and storage cask, welding of the lid and port cover plates, Forced Helium Dehydration (FHD) drying, helium backfill of the canister, and transportation of the canister into the UMAX ISFSI. The first canister was placed into the UMAX ISFSI on September 1, 2015.

Non-Destructive Examination

- The requirements to perform helium leak testing of each canister was incorporated into the licensee’s procedures. The helium leak testing equipment used during the initial loading operations was verified to meet the minimum sensitivity level specified in ANSI N14.5.

- A review of the visual and liquid penetrant examination specialists’ qualifications identified that they were properly qualified as a Level II examiners.

- The welding contractor, utilized by Callaway for dry cask storage operations, implemented visual and liquid penetrant examination procedures that met all the applicable requirements from ASME Section III, Section IV, and the FSAR in regards to non-destructive examination of welds.

Pressure Testing

- The requirements for canister hydrostatic testing had been incorporated into the licensee’s procedure and were consistent with the requirements of ASME Section III Subsection NB, Article NB-6000.

- The hydrostatic testing sequence and criteria described in the FSAR had been incorporated into the licensee’s procedures.

Quality Assurance

- The licensee had implemented their approved reactor facility Part 50 quality assurance program for the activities associated with the ISFSI. Selected Quality Assurance (QA) activities were reviewed related to calibrations, operating status, receipt inspections, QA surveillances, and QA audits.

- The FSAR identified structures, systems, and components that were important to safety and categorized each item into one of three levels (A, B, or C) based on safety significance. The licensee incorporated Holtec’s safety designations into their classification procedure used to determine the level of quality control to place on the items.

- A corrective action program that documented issues and classified problems according to their impact on quality and safety was being effectively used by the licensee. Selected condition reports were reviewed to verify adequate resolution of the issues.

Radiation Protection

- The licensee had incorporated As Low As Reasonably Achievable (ALARA) planning into the dry cask loading program. This included developing reasonable dose goals, utilizing lessons learned from other sites, and conducting radiation pre-job briefings that identified expected radiological conditions for the different work evolutions.

- Requirements for radiological and contamination surveys described in the FSAR and technical specifications had been incorporated into the licensee’s health physics program for the loading of the canisters. This included decontamination of the transfer cask and canister lid, and performing required surveys of the transfer cask and loaded VVM.

- The licensee incorporated proper neutron dose consideration into the health physics monitoring program for neutrons that would be present around the canister when empty of water. This consideration included the use of appropriate personnel dosimetry that could measure neutron doses and applying a correction factor based on survey readings obtained during the loading campaign.

Records

- The licensee was maintaining the ISFSI records in their quality related records system. Records required for retention by 10 CFR 72.174, 10 CFR 72.212, 10 CFR 72.234, and the FSAR had been identified in the licensee's program as required records for retention. The records were required to be maintained for five years after the transfer of the fuel from the ISFSI.

Safety Reviews

- Changes to the site related to the construction and operation of the ISFSI were being evaluated in accordance with 10 CFR 72.48 and 10 CFR 50.59 requirements. No issues were identified during the review of selected safety screenings and full safety evaluations.

Slings

- The slings used for downloading the MPC and other slings utilized throughout the campaign met the requirements of NUREG 0612. Operations required dual/redundant slings that had a rated capacity of twice the sum of the static and dynamic loads. All slings' proof loading tests were found to meet the requirements of ASME B30.9.

- The sling inspection program complied with ASME B30.9 in regards to daily sling inspections, annual sling inspections, and proof loading.

Special Lifting Devices

- The licensee's special lifting device program complied with ANSI N14.6 in regards to stress design, prior to use inspections, and 300% proof loadings for the lift yoke, lift yoke extensions, HI-TRAC VW Lift Lugs, MPC lift cleats, and the VCT lift links.

Storage Operations

- The inspection of the VVM outlet and inlet air ducts to be free from blockage was placed in the licensee's procedures to be performed daily as required by Technical Specification A.3.1.2.

Unloading

- The licensee procured the equipment and developed procedures to perform gas sampling if a canister was required to be unloaded. The licensee demonstrated the gas sampling process to the NRC during the dry run demonstrations.

- Canister re-flooding for unloading was demonstrated to the NRC during the dry run demonstrations. The procedure controlling canister re-flooding contained all of the applicable requirements from the FSAR and the technical specifications.

Welding

- Requirements for hydrogen monitoring during welding of the canister lid had been incorporated into the licensee's procedures.

- All welding procedures contained the required essential, non-essential, and supplemental variables specified in ASME Section IX for gas tungsten arc welding.

- The welding procedure's qualification test coupons all satisfactorily passed the required bend and tension tests to qualify the welding procedures and thus the lid to shell weld.

- The welder's performance qualification test records were reviewed and documented that the welders had met the qualification testing requirements for manual and machine welding of the canister lid. The testing requirements complied with the requirements of ASME Section IX.

SUPPLEMENTAL INSPECTION INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

R. Brumnet, Consultant, QC Inspector
C. Emerson, Consultant, Radiation Protection
D. Daugherty, QC Inspector
S. Ewens, ISFSI Project Manager
R. Lutz, Lead Project Engineer
M. McLachlan, Senior Director Engineering
J. Mcinvale, Consultant, Project Engineer
T. Pettus, Project Engineer
L. Ptasznik, Regulatory Affairs
G. Roesner, Consultant, Project Engineer
D. Shafer, Consultant, Regulatory Affairs
E. Stewart, Senior Reactor Operator

Holtec International

B. Bates, Field Supervisor
A. Brown, Project Engineer
D. Burns, Welder/Machine Operator
T. Card, Project Manager
T. Ciesielski, Welder/Machine Operator
N. DeDominicis, HMD Manager of Projects
L. Johnson, Field Supervisor
L. Kinney, Site Manager
S. Roland, Operations Manager
J. Sloane, Field Supervisor
S. Soler, Director Site Services Manager
R. Tindal, Project Manager
T. Witt, Regulatory Affairs

PCI Group

R. Campbell, Welder
D. O'Conner, NDE Inspector
L. Hobson, Welder
J. Meyers, Welding Supervisor
L. Vice, NDE Inspector
J. York, Welder

INSPECTION PROCEDURES USED

IP 60854.1	Preoperational Testing of ISFSIs at Operating Plants
IP 60855.1	Operations of an ISFSI at Operating Plants
IP 60856	Review of 10 CFR 72.212(b) Evaluations
IP 60857	Review of 10 CFR 72.48 Evaluations

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Discussed

None

Closed

None

LIST OF ACRONYMS

abs	absolute
ADAMS	Agencywide Documents Access and Management System
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ASHRAE	American Society of Heating Refrigerating and Air-Conditioning Engineer
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
atm	atmosphere
AWS	automatic welding system
BP	Burnable Poison Rod Assembly
CAL	Calculation
CAR	Corrective Action Request
CARS	Corrective Action Request System
CEC	Cavity Enclosure Container
cc/sec	cubic centimeters per sec
CFR	Code of Federal Regulations
CLP	Cask Loading Pit
cm	centimeter
CMAA	Crane Manufacturers' Association of America
CMTR	certified materials test report
CoC	Certificate of Compliance
CWP	Cask Washing Pit
DBE	Design Basis Earthquake
DFC	damaged fuel container
DNMS	Division of Nuclear Material Safety
dpm	disintegrations per minute
EAL	emergency action level
EPD	electronic pocket dosimeter

EPP	emergency plan procedure
EPRI	Electrical Power Research Institute
F	Fahrenheit
FHD	forced helium dehydration
fps	feet per second
FSAR	Final Safety Analysis Report
g	acceleration due to gravity
gpm	gallons per minute
GQP	General Quality Procedure
GTAW	gas tungsten arc welding
GWD/MTU	Giga Watt Day per Metric Ton Uranium
GWS	General Welding Standard
HI	Holtec International
HI-PORT	Low Profile Transporter
HI-TRAC VW	Holtec Transfer Cask
HMD	Holtec Manufacturing Division
HMSLD	helium mass spectrometer leak detector
HSP	Holtec Standard Procedure
HPP	Holtec Project Procedure
HVAC	heating, ventilating, and air-conditioning
ICRP	International Commission Radiation Protection
ICA	item control area
IP	Inspection Procedure
IPTE	Infrequently Performed Test Evolution
ISFSI	Independent Spent Fuel Storage Installation
ISG	Interim Staff Guidance
ITS	important to safety
IWRC	independent wire rope core
kW	killo-watt
lbs	pounds
LCO	limiting condition for operation
m/sec	meters per second
MPC	multi-purpose canister
mrem	MilliRoentgen Equivalent Man
MSLD	mass spectrometer leak detector
MWD/MTU	Mega Watt Day per Metric Ton Uranium
NDE	non-destructive examination
NOG	Nuclear Overhead and Gantry (Cranes)
NEI	Nuclear Energy Institute
NIST	National Institute of Science and Technology
NITS	not important to safety
NRC	Nuclear Regulatory Commission
NSA	Neutron Source Assembly
NUREG	US Nuclear Regulatory Commission Regulation
OCA	owner controlled area
OSL	optically stimulated luminescence
OQAM	Operating Quality Assurance Manual
PCI	Westinghouse Electric Company Welding Service
PII	personally identifiable information
PM	preventative maintenance
PQR	procedure qualification record

PS	Purchase Specification
psig	pounds per square inch gauge
PT	liquid penetrant exam
PWR	pressurized water reactor
QA	quality assurance
QC	quality control
RCCA	Rod Cluster Control Assemblies
RERP	Radiological Emergency Response Plan
RIV	Region 4
RVOA	removable valve operator assembly
RWP	radiation work permit
S/N	serial number
SER	Safety Evaluation Report
SFP	spent fuel pool
SNM	special nuclear material
SNT-TC	Society for Non-Destructive Testing-Technical Committee
Spec	Specification
SSC	structures, systems, and components
SSE	safe shutdown earthquake
TAL	threaded anchor location
TEPC	Tissue Equivalent Proportional Chamber
TLD	thermo-luminescent dosimetry
TP	Thimble Plug
TS	technical specification
U-235	Uranium 235
UFSAR	Updated Final Safety Analysis Report
UFSAR-SA	Updated Final Safety Analysis Report Site Addendum
UFSAR-SP	Updated Final Safety Analysis Report Standard Plant
VCT	vertical cask transporter
VVM	Vertical Ventilated Module
VT	Visual Testing
WOPQ	welder operator performance qualification
WPQ	welder performance qualification
WPS	welding procedure specification
ZPA	Zero Period Accelerations
Zr	zirconium based fuel cladding

ATTACHMENT 2

CALLAWAY INSPECTOR NOTES

CALLAWAY INSPECTOR NOTES

Category: Canister Drying/Inerting **Topic:** Dryness Levels

Reference: CoC 1040, Tech Spec A.3.1.1.1 and Table 3-1 Amendment 0

Requirement When using the forced helium dehydration (FHD) system for moisture removal, the gas temperature exiting the demoisturizer shall be 21 degrees F or less, for 30 minutes or more, or the gas dew point exiting the canister shall be 22.9 degrees F or less, for 30 minutes or more.

Observation: The procedures used at Callaway for canister sealing exceeded the dryness requirements established by the Certificate of Compliance (CoC). The spent fuel canisters used at Callaway used the forced helium dehydration (FHD) system to ensure that fuel dryness levels were adequately obtained. Certificate of Compliance (CoC) 1040 Technical Specification (TS) surveillance requirement 3.1.1.1 and Table 3-1 required that the gas temperature exiting the demoisturizer be less than or equal to 21 degrees F for 30 minutes or more, or that the gas dew point exiting the canister be less than or equal to 22.9 degrees F for 30 minutes or more. These TS requirements were placed in the Holtec procedure HPP-2253-300 for canister sealing. However, the procedures used at Callaway conservatively exceeded the dryness levels required by the Holtec CoC TSs. The procedure used at Callaway required the temperature leaving the demoisturizer to be no more than 16 degrees F for 30 minutes or more. The gas dew point sensor was utilized by the system earlier in the FHD process at Callaway, but the licensee used the demoisturizer exiting temperature for the TS surveillance to ensure the system was dry.

Documents Reviewed: a) Holtec Procedure HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: Canister Drying/Inerting **Topic:** Forced Helium Dehydration System (FHD)

Reference: CoC 1040, Appendix A, Section 3.6.1, Table 3-1 Amendment 0

Requirement For canisters containing one or more fuel assemblies with burnup values greater than 45 GWD/MTU, forced helium dehydration must be used for canister drying. For all other canisters, either forced helium dehydration or vacuum drying may be used for canister drying, unless MPC-37 is loaded using Figure 2.3-12.

Observation: Use of the forced helium dehydration system was planned for all canisters loaded at Callaway. The first canister contained assemblies with a burnup of greater than 45 GWD/MTU. The licensee demonstrated the use of the forced helium dehydration system during the dry run conducted the week of June 2-4, 2015. Procedure HPP-2253-300 provided instructions for use of the system. Use of the forced helium dehydration system was always required in Procedure HPP-2253-300, and as such, the criteria in Technical Specification A.3.6.1 was not specified in the procedure.

Documents Reviewed: a) Holtec Procedure HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: Canister Drying/Inerting **Topic:** Helium Backfill Pressure

Reference: CoC 1040, Tech Spec A.3.1.1.2, Table 3-2, et al. Amendment 0

Requirement For the MPC-37 canister with Standard Fuel, backfill pressure shall be as follows: for cask heat loads less than or equal to 33.88 kW, using canister loading option depicted in Figure 2.3-1 helium backfill shall be equal to or greater than 41.0 psig up to 44.2 psig. The pressure range is at a reference temperature of 70 degree F.

Observation: All canisters loaded at Callaway were restricted to the loading option depicted in CoC Appendix B, Figure 2.3-1 "UMAX MPC-37 Permissible Heat Load Chart 1 for Long-term Storage for Short and Standard Fuel" and a helium backfill pressure range of equal to or greater than 41.0 psig up to 44.2 psig (at 70 degree F) per procedure ETP-ZZ-04020.

Helium backfill pressure requirements were incorporated into Procedure HPP-2253-300 consistent with the requirements in TS A.3.1.1.2 and Table 3-2. Procedure HPP-2253-300, Section 7.10, "FHD Helium Backfill Operation," provided instructions for the helium backfill operations. Step 7.10.7 of Procedure HPP-2253-300 used Attachment 8.6 "FHD Helium Backfill Pressure Chart" to determine the acceptable pressure range at different temperatures based on a 70 degree F reference temperature.

Documents Reviewed: a) Certificate of Compliance No. 1040, "For the HI-STORM UMAX Cask Storage System," Amendment 0; b) Callaway Procedure ETP-ZZ-04020, "Fuel Selection and Cask Loading for Dry Cask Storage," Revision 0; c) Holtec Procedure HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: Crane Design **Topic:** Bridge and Trolley Brakes

Reference: NUREG 0554, Section 5.1 Published May 1979

Requirement Bridge and trolley control and holding brakes should be: a) rated at 100% of maximum drive torque that can be developed at the point of application; b) adjusted with one brake in each system leading the other; and c) automatically actuate on interruption of power and overspeed. The holding brakes should be designed so that they cannot be used as foot-operated slowdown brakes. Drag brakes should not be used.

Observation: The bridge and trolley brakes on the single-failure proof crane met the NUREG requirements. The bridge/trolley control and the holding brakes were capable of applying a counter torque that would be 100% of maximum drive torque that could be developed at the point of application. The trolley and bridge brakes were provided in arrangements in accordance with the Crane Manufacturers Association of America (CMAA) Spec #70-2010 with one brake system leading the other. The bridge and trolley motors were provided with spring set, electronically released holding brakes that would automatically apply when power became interrupted. The design of the bridge and trolley holding brakes were such that they cannot be used as a foot-operated slowdown brake and drag brakes were not used for the bridge or trolley drives.

Documents Reviewed: a) American Crane and Equipment Corporation Document REP-2150-003, "NUREG 0554/0612 Compliance/Safety Analysis Report for the Cask Handling Crane Upgrade Holtec International/Ameren's Callaway Energy Center," Revision 0

Category: Crane Design **Topic:** Drum Safety Devices

Reference: NUREG 0554, Section 4.2 Published May 1979

Requirement The hoist drum should be provided with structural and mechanical safety devices to limit its drop during a shaft or bearing failure. The devices should prevent disengaging from the holding brake.

Observation: The single-failure proof crane at Callaway met the design requirement. The main hoist drum retaining devices were steel structures, which ensured that a shaft or bearing failure would not allow the main hoist drums to disengage from the brakes.

Documents Reviewed: a) American Crane and Equipment Corporation Document REP-2150-003, "NUREG 0554/0612 Compliance/Safety Analysis Report for the Cask Handling Crane Upgrade Holtec International/Ameren's Callaway Energy Center," Revision 0

Category: Crane Design **Topic:** Emergency Stop Feature

Reference: NUREG 0554, Sections 3.3, 6.1, and 6.6 Published May 1979

Requirement An emergency stop feature should be installed at the control station. For cranes remotely operated using radio control stations, a second emergency stop feature should be provided at ground level to remove power from the crane, independent of the controller. Cranes that use more than one control station should be provided with electrical interlocks that permit only one control station to be operated at a time.

Observation: The requirement for an emergency stop button to exist on both the remotely operated overhead crane belly box (both the pendant and radio remote controls) and in another redundant location accessible from the ground floor was visually verified by NRC inspectors during preoperational dry-runs at the Callaway Nuclear Station. The presence and locations of the emergency stop buttons was also detailed in the American Crane NUREG 0554 Compliance Report.

Documents Reviewed: a) American Crane and Equipment Corporation Document REP-2150-003, "NUREG 0554/0612 Compliance/Safety Analysis Report for the Cask Handling Crane Upgrade Holtec International/Ameren's Callaway Energy Center," Revision 0

Category: Crane Design **Topic:** Seismic Events During Cask Movement

Reference: NUREG 0554, Section 2.5 Published May 1979

Requirement The crane should be designed to retain control of and hold the load, and the bridge and trolley should be designed to remain in place on their respective runways with their wheels prevented from leaving the tracks during a seismic event.

Observation: The crane was designed to retain control of and hold the load during a seismic event. The trolley was designed to remain in place on their respective runways with their wheels prevented from leaving the tracks during a seismic event. The new trolley, including main hoist, was designed and fabricated to meet CMAA Specification #70-2010, ASME NOG-1-2004, and NUREG 0554 requirements. The main-hoist was single-failure-proof and designed to maintain control of the maximum rated load during the seismic spectra specifications from the plant's Part 50 Updated Final Safety Analysis Report (UFSAR). This analysis was documented in Calculation CAL-21250-SE-001 "Crane Structural Analysis & Trolley Evaluation" and in the licensee's 50.59 screen MP 14-0014 "Dry Fuel Storage Licensing and Operations Documentation (Heavy Loads Review)."

Documents Reviewed: a) Calculation CAL-21250-SE-001, "Crane Structural Analysis & Trolley Evaluation," Revision 1; b) 50.59 Screen MP 14-0014, "Dry Fuel Storage Licensing and Operations Documentation (Heavy Loads Review)," Revision 0

Category: Crane Design **Topic:** Seismically Induced Load Swing

Reference: NUREG 0554, Section 2.5; Reg Guide 1.29 Published May 1979

Requirement The maximum critical load plus operational and seismically induced pendulum and swing load effects on the crane should be considered in the design of the trolley and should be added to the trolley weight for the design of the bridge.

Observation: The maximum critical load plus the swing load effects due to a seismically induced pendulum was included in the design calculations associated with Callaway's 125-ton fuel building crane. Licensee Calculation CAL-21250-SE-001 "Crane Structural Analysis & Trolley Evaluation" included the crane with the maximum crane load suspended from the trolley at several locations along the bridge and at several heights within the fuel building. A linearly elastic, static finite element analysis was used to obtain operational load analyses and environmental seismic member forces. The computer program used for this calculation was the SAP2000 Version 15.1.0, which was permitted by the Part 50 program's UFSAR. The analyses determined that the trolley members and connections satisfied all allowable stress criteria set forth in CMAA #70-2010 and ASME NOG-1.

Documents Reviewed: a) Calculation CAL-21250-SE-001, "Crane Structural Analysis & Trolley Evaluation," Revision 1; b) 50.59 Screen MP 14-0014, "Dry Fuel Storage Licensing and Operations Documentation (Heavy Loads Review)," Revision 0

Category: Crane Design **Topic:** Single Failure Proof Crane

Reference: NUREG 0554, Section 1.0 Published May 1979

Requirement When reliance for the safe handling of critical loads is placed on the crane system itself, the system should be designed so that a single failure will not result in the loss of the capability of the system to safely retain the load.

Observation: The original cask handling crane in Callaway's fuel handling building was a non-single-proof 150-ton crane. In early 2014, Callaway replaced the 150-ton non-single failure proof crane/trolley with a new 125-ton single-failure proof crane/trolley from American Crane and Equipment Corporation. This new 125-ton single-failure proof crane was designed to meet the requirements of NUREG-0554, NUREG 0612, CMAA #70-2010, ASME B30.2, and ASME NOG-01.

Documents Reviewed: a) American Crane and Equipment Corporation Document REP-2150-003, "NUREG 0554/0612 Compliance/Safety Analysis Report for the Cask Handling Crane Upgrade Holtec International/Ameren's Callaway Energy Center," Revision 0; b) 50.59 Screen MP 14-0014, "Dry Fuel Storage Licensing and Operations Documentation (Heavy Loads Review)," Revision 0

Category: Crane Design **Topic:** Two-Block Protection

Reference: NUREG 0554, Section 4.5 Published May 1979

Requirement The complete hoisting system should have the required strength to resist failure during two-blocking. As an alternative, a system of upper travel limit switches may be used to prevent two-blocking. The system should include two independent travel limit devices of different designs and activated by separate mechanical means. These devices should de-energize the hoist drive motor and the main power supply. The auxiliary hoist, if used for critical lifts, should also be equipped with two independent travel limit switches to prevent two-blocking.

Observation: The requirement for two-block protection was met at Callaway through the design of the main hoist that allowed the crane to two-block without cutting or crushing the wire ropes or causing permanent deformation or damage to the crane. In addition, redundant and independent upper travel limit switches to prevent two-blocking from ever occurring were also incorporated into the design. As such, the Cask Handling Crane used at Callaway had multiple paths of two-block protection.

Documents Reviewed: a) American Crane and Equipment Corporation Document REP-2150-003, "NUREG 0554/0612 Compliance/Safety Analysis Report for the Cask Handling Crane Upgrade Holtec International/Ameren's Callaway Energy Center," Revision 0

Category: Crane Design **Topic:** Wire Rope Breaking Strength

Reference: NUREG 0554, Section 4.1 Published May 1979

Requirement The maximum load (including static and inertia forces) on each individual wire rope in the dual reeving system with the maximum critical load attached should not exceed 10% of the manufacturer's published breaking strength.

Observation: The 125 ton single failure proof crane's wire rope met the NUREG 0554 requirement. The maximum load rating for the main hoist was 125-tons or 250,000 lbs. The wire ropes used on the main hoist were rated for 195,800 lbs. The main hoist utilized two Python Power 9V EEIPS wire ropes that were each 1-1/8" nominal diameter and length of 775 ft through an 8-part reeving system. Therefore the stress in each individual wire rope from the maximum load would be 15,625 pounds (250,000/16). Ten percent of the manufacturer's published breaking stress for the wire rope was 19,580 lbs. Therefore the maximum load on the wire rope at maximum rated load was 15,625 lbs, which is less than 10 percent of the published breaking strength of 19,580 lbs, meeting the NUREG requirement.

Documents Reviewed: a) UNIROPE Test Certificate No 191303 Item #5 Rel #2, Dated 12/12/2013; b) UNIROPE Test Certificate No 191303 Item #2 Rel #2, Dated 12/10/2013

Category: Crane Design **Topic:** Wire Rope Configuration

Reference: NUREG 0554, Section 4.1 Published May 1979

Requirement A dual rope reeving system with individual attaching points and a load balancing system will permit either rope system to hold and transfer the critical load without excessive shock in case of failure of the other rope system. The dual reeving system may be a single rope from each end of the drum terminating at one of the blocks or equalizer with provisions for equalizing beam-type load and rope stretch, with each rope designated for the total load. Alternatively, a 2-rope system may be used from each drum or separate drums using a sheave equalizer or beam equalizer or other combination that provides two separate and complete reeving systems.

Observation: The single-failure proof crane at Callaway met the NUREG requirement. The 125-ton crane at Callaway used two drums with two ropes, with a balanced dual reeving system with each rope terminating on the drum it originated on.

Documents Reviewed: a) American Crane and Equipment Corporation Document REP-2150-003, "NUREG 0554/0612 Compliance/Safety Analysis Report for the Cask Handling Crane Upgrade Holtec International/Ameren's Callaway Energy Center," Revision 0

Category: Crane Inspection **Topic:** Crane Inspection - Frequent

Reference: ASME B30.2; Section 2-2.1.2 Published 1976

Requirement Cranes in regular use shall be subjected to a frequent crane inspection monthly during normal service, weekly to monthly during heavy service, and daily to weekly during severe service. The frequent inspection points shall include: a) operating mechanisms for proper operation daily; b) all limit switches should be checked at the beginning of each work shift by inching, or running at slow speeds, each motion into its limit switch; c) leakage in lines, tanks, valves, pumps, and other parts of the air or hydraulic systems; d) hooks for cracks, more than 15% of normal throat opening, or more than 10 degrees of twist; e) hook latches for proper operation; f) hoist ropes including end clamps; and g) the rope reeving system.

Observation: NRC inspectors verified via procedure review that the frequent cask handling crane inspections performed at Callaway would look for the following items: proper operation of operating mechanisms, limit switch functionality, fluid leaks, hook and latch wear and operation, wire rope end connections, and proper spooling on the drum. The 125-ton crane was daily inspected in accordance with ASME B30.2, Section 2-1.1.2.

Documents Reviewed: a) Callaway Procedure OTS-KE-00016, "Operation of the Cask Handling Crane," Revision 22; b) Job Order #15500182.500, "Semi-Annual Crane Inspection HKE14 (Mechanical)," Revision 3

Category: Crane Inspection **Topic:** Crane Inspection - Periodic

Reference: ASME B30.2; Section 2-2.1.3 Published 1976

Requirement Cranes in regular use shall be subjected to a periodic crane inspection annually during normal and heavy service, and quarterly during severe service. The periodic inspection includes checking for: a) deformed, cracked or corroded members; b) loose bolts or rivets; c) cracked or worn sheaves and drums; d) worn, cracked or distorted pins, bearings, shafts, gears, and rollers; e) excessive brake system wear; f) load, wind, and other indicators over their full range for any significant inaccuracies; g) gasoline, diesel, electric, or other power plants for improper performance; h) excessive drive chain sprocket wear and chain stretch; and i) deterioration of controllers, master switches, contacts, limit switches and pushbutton stations.

Observation: The periodic crane inspection was performed as required. Callaway had implemented three different job orders to inspected the 125-ton fuel building crane. Job Order #14502408.500 "Annual Crane Maintenance and Inspection (HKE14)," contained annual mechanical inspection requirements and was completed on June 20, 2015. Job Order #14502408.321 "Annual Crane Inspection HKE14 (Electrical)," contained electrical inspection requirements and was completed June 25, 2015. Job Order #15500182.500 "Semi-Annual Crane Inspection HKE14 (Mechanical)," contained additional mechanical inspection requirements and was completed June 20, 2015. All ASME B30.2 inspection requirements were captured between the three inspection procedures and were being performed on an annual or semi-annual basis.

Documents Reviewed: a) Job Order #14502408.500, "Annual Crane Maintenance and Inspection (HKE14)," Revision 2; b) Job Order #14502408.321, "Annual Crane Inspection HKE14 (Electrical)," Revision 1; c) Job Order #15500182.500, "Semi-Annual Crane Inspection HKE14 (Mechanical)," Revision 3

Category: Crane Inspection **Topic:** Crane Operational Testing

Reference: ASME B30.2; Sect 2-2.2.1 Published 1976

Requirement Prior to initial use, all new, reinstalled, extensively repaired, or modified cranes shall have the following functions tested: (a) lifting and lowering, (b) trolley travel, (c) bridge travel, (d) limit switches, and (e) locking and safety devices. The trip setting of the hoist limit devices shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit device shall be located so that it will trip the device under all conditions in sufficient time to prevent contact of the hook or load block with any part of the trolley or crane.

Observation: All ASME B30.2 operational testing requirements were tested during the site acceptance test performed in June of 2014 per Procedure REP-21250-007.

Documents Reviewed: a) Procedure REP-21250-007, "American Crane & Equipment Corporation Site Load Test," Revision 1

Category: Crane Inspection **Topic:** Hoist Overload Testing

Reference: NUREG 0554, Section 8.3; NUREG 0612, C-4, (9) Published 1979/1980

Requirement If the hoisting system is designed with adequate strength to resist failure during load hang-up, the hoisting system should be tested by securing the load-block-attaching points to a fixed anchor and applying the maximum critical load. Alternately, if a load cell system, a motor current-sensing device, or a mechanical load-limiting device is provided to prevent load hang-up, the device(s) should be tested to verify operability.

Observation: Testing was performed that met the NUREG requirement. A two-block test of the main hoist was performed during factory functional testing at American Crane & Equipment Corporation's factory on March 27, 2014 per REP-21250-004 and REP-21250-005. The overweight limits on the main hoist were calibrated and tested during the factory load testing. The proper operation of the mechanical slip clutch, which was present to mitigate the effects of two-blocking or load hang-up event, was verified for the 125-ton main hoist.

Documents Reviewed: a) Procedure REP-21250-004, "American Crane & Equipment Corporation Factory Functional Test Procedure," Revision 1; b) Procedure REP-21250-005, "American Crane & Equipment Corporation Factory Load Test Procedure," Revision 1

Category: Crane Inspection **Topic:** Hook Inspections - Frequent/Periodic

Reference: ASME B30.10, Sections 10-1.4.2 and 10-1.4.6 Published 1975

Requirement Hooks shall be inspected monthly during normal service, weekly to monthly during heavy service and daily to weekly during severe service. Hooks should be inspected for: a) distortion such as bending, twisting or increased throat opening; b) wear; c) cracks, severe nicks, or gouges; d) latch engagement, damaged or malfunctioning latch (if provided); and e) hook attachment and securing means. Hooks having any of the following deficiencies shall be removed from service unless a qualified person approves their continued use and initiates corrective action: a) cracks; b) wear exceeding 10% of the original sectional dimension; c) bend or twist exceeding 10 degrees from the plane of an unbent hook; and d) an increase in throat opening of 15% (for hooks without latches).

Observation: NRC inspectors verified via procedure review that Callaway met the hook inspection requirements of ASME 30.10, "Hooks," in its frequent (daily) or periodic (semi-annual) crane hook inspections. This criteria included inspections of the hook attachment points, for distortion, cracks, and wear, and for crane hook latch engagement problems. These requirements were met for both the 125-ton main hoist as well as the 5-ton auxiliary hoist.

Documents Reviewed: a) Callaway Procedure OTS-KE-00016, "Operation of the Cask Handling Crane," Revision 22; b) Job Order #15500182.500, "Semi-Annual Crane Inspection HKE14 (Mechanical)," Revision 3

Category: Crane Inspection **Topic:** Wire Rope Inspection - Frequent

Reference: ASME B30.2, Section 2-2.4.1 (a) Published 1976

Requirement All ropes shall be visually inspected once each working day.

Observation: NRC inspectors verified via procedure review that Callaway met the requirements of ASME B30.10, Section 2-2.4, "Rope Inspection, Replacement, and Maintenance." According to the procedure used at Callaway, the wire rope is to be inspected prior to each shift as part of an operational check. The procedure required that the wire rope be inspected for broken/damaged wire, excessive wear, kinks, distortion, corrosion, and problems with the end clips/rope attachment points.

Documents Reviewed: a) Callaway Procedure OTS-KE-00016, "Operation of the Cask Handling Crane," Revision 22

Category: Crane Inspection **Topic:** Wire Rope Replacement Criteria

Reference: ASME B30.2, Section 2-2.4.2 Published 1976

Requirement Conditions such as the following should be sufficient reason for questioning continued use of the rope, or increasing the frequency of inspection: a) twelve randomly distributed broken wires in one lay; b) wear of one-third of the original diameter of outside individual wires; c) kinking, crushing, bird caging or any other damage resulting in distortion of the rope structure; d) evidence of heat damage; and e) reduction in diameter in excess of nominal.

Observation: The wire rope on the 125-ton crane was inspected to the ASME B30.2, Section 2-2.4.2 criteria semi-annually per Job Order #15500182.500, "Semi-Annual Crane Inspection HKE14 (Mechanical)." The last semi-annual inspection was conducted on June 20, 2015. Steps 5.1.9 from the Job Order contained the ASME B30.2 Section 2-2.4.2 wire rope inspection requirements.

Documents Reviewed: a) Job Order #15500182.500, "Semi-Annual Crane Inspection HKE14 (Mechanical)," Revision 3

Category: Crane Load Testing **Topic:** Cold Proof Testing

Reference: NUREG 0554, Section 2.4; NUREG 0612, C-2 (8) Published 1979/1980

Requirement Minimum operating temperatures for the crane should be specified to reduce the possibility of brittle fracture of the ferritic load-carrying members of the crane. The minimum temperature can be determined by: 1) a drop weight test per ASTM E-208, 2) a Charpy test per ASTM A-370, or 3) a 125% cold proof test. If the crane is made of low alloy steel such as ASTM A514, cold proof testing should be done. If cold proof testing is omitted, the default minimum crane operating temperature is 70 degrees F. For crane operation at temperatures below 70 degrees F, cold proof testing must be performed and the ambient temperature at which the testing is conducted becomes the minimum crane operating temperature.

Observation: The 125-ton crane's operating temperature was set per procedure requirements to exceed 70 degrees F. The MPC loading procedure in step 5.11 required operators to ensure cask handling crane temperature to be greater than 70 degrees F.

Documents Reviewed: a) Callaway Procedure APA ZZ-00365-Addendum L, "Callaway Lifting Operations," Attachment 10, Table 1, "Fuel Handling Crane Data," Revision 18; b) Holtec Procedure HPP-2253-200, "MPC Loading at Callaway," Revision 9

Category: Crane Load Testing **Topic:** Dynamic Load Testing (100%)

Reference: NUREG 0554, Section 8.2 Published May 1979

Requirement After the 125% static load test, the crane should be given a full performance test with 100% of the maximum critical load attached, for all speeds and motions for which the system is designed. This should include verifying all limiting and safety control devices.

Observation: A full performance test with 100% of the maximum critical load attached was performed for all speeds and motions for which the system was designed. The 100% site load test was completed on June 4, 2014. Procedure REP-21250-007 page 12 of 41, documented that the licensee satisfactorily performed the test with a load of 253,100 lbs. All speeds and motions were tested as well as the limiting and safety control devices.

Documents Reviewed: a) Procedure REP-21250-007, "American Crane & Equipment Corporation Site Load Test," Revision 1

Category: Crane Load Testing **Topic:** Hook Load Testing

Reference: NUREG 0554, Sect 4.3; ASME B30.10, Sect 10-1.1.2 Published 1979/1975

Requirement A 200% static load test should be performed for each load-attaching hook. For a duplex (sister) hook, the proof load shall be shared by the two sisters unless the hook is designed for unbalanced loading. Measurements of the geometric configuration of the hooks should be made before and after the test and the acceptance criteria is no permanent increase in throat opening in excess of 0.5% or 0.010 inches (0.25 mm). The load testing should be followed by a nondestructive examination that should consist of volumetric and surface examinations to verify the soundness of fabrication and ensure integrity of the hooks.

Observation: A static hook load test of 200% was performed on the 125-ton main hoist of the fuel building crane. A 150-ton hook was purchased for the new fuel building crane. McKissick Certificate of Conformance No 840554 documented that the 150-ton hook was proof load tested to 600,000 lbs on February 19, 2014.

Documents Reviewed: a) McKissick Certificate of Conformance Test Certificate No 840554, "Certificate of Test and Examinations of Chains, Rings, Hooks, Shackles, Swivels, and Pulley Blocks," dated 03/12/14

Category: Crane Load Testing **Topic:** NDE Exams Following Cold-Proof Testing

Reference: NUREG 0554, Section 2.4 and 2.6 Published May 1979

Requirement Following the 125% cold-proof testing, a nondestructive examination of the welds whose failure could result in the drop of a critical load should be performed. If any of these weld joint geometries would be susceptible to lamellar tearing, the base metal at the joints should be nondestructively examined. Nondestructive examination of critical areas should be repeated at 4-year intervals or less.

Observation: Cold proof testing was performed at Callaway following the 125-ton crane's static load test at 125% of the rated capacity. Non-destructive examination was performed on the critical welds identified by the licensee. The welds examined were documented in Attachment A-1 "Table of Required Inspections, Test, and Documentation" and in Attachment A-2 "Identification of Critical Welds & Brittle Fracture Concerns for Existing Bridge Structure for the Cask Handling Crane Upgrade" of American Crane and Equipment Corporation Document REP-2150-003.

Documents Reviewed: a) Callaway Procedure APA ZZ-00365-Addendum L, "Callaway Lifting Operations," Attachment 10, Table 1, "Fuel Handling Crane Data," Revision 18; b) Holtec Procedure HPP-2253-200, "MPC Loading at Callaway," Revision 9; c) American Crane and Equipment Corporation Document REP-2150-003, "NUREG 0554/0612 Compliance/Safety Analysis Report for the Cask Handling Crane Upgrade Holtec International/Ameren's Callaway Energy Center;" Revision 0

Category: Crane Load Testing **Topic:** Rated Load Marking

Reference: NUREG 0554, Section 8.5; ASME B30.2, Sect 2- Published 1976

Requirement The rated load shall be marked on each side of the crane and, if the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or on its load block.

This marking shall be legible from the ground or floor.

Observation: The rated load of the fuel building overhead crane at Callaway was marked on each side of the crane and on each of the hoists. The fuel building crane was rated as 125 tons. One other hoist was located on the crane as well, a 5-ton hoist.

Documents Reviewed: a) NUREG 0554, "Single Failure Proof Cranes for Nuclear Power Plants," published May 1979

Category: Crane Load Testing **Topic:** Static Load Testing (125%)

Reference: NUREG 0554, Section 8.2 Published May 1979

Requirement The crane should be static load tested at 125 percent of the maximum critical load. The test should be conducted at all positions generating maximum strain in the bridge and trolley structures and other positions as recommended by the designer or manufacturer.

Observation: A static load test at 125% of the maximum critical load attached was performed at Callaway on June 4, 2014. Procedure REP-21250-007, page 23, documented that the licensee satisfactorily performed the test with a load of 318,200 lbs.

Documents Reviewed: a) Procedure REP-21250-007, "American Crane & Equipment Corporation Site Load Test," Revision 1

Category: Crane Operation **Topic:** Brake Test Prior to Lift

Reference: ASME B30.2, Section 2-3.2.3 (g) Published 1976

Requirement The operator shall check the hoist brakes at least once each shift if a load approaching the rated load is to be handled. This shall be done by lifting the load a short distance and applying the brakes.

Observation: This requirement had been adequately incorporated into the lifting procedures at Callaway. Callaway's lifting operations procedure included step 4.2.1.t that described the "lift and hold test" for all lifts performed with the main hoist during fuel building operations. In this step, all loads were lifted to clear the ground or securing device for underwater lifts and the load was held long enough to listen for unusual sounds, check the load on the load indicator, review and inspect the rigging, and to ensure that the load is stable. A similar step was included in the lifting and rigging program procedure in step 4.2.3. The crane operating procedures used at Callaway were compliant with the brake testing criterion of ASME B30.2.

Documents Reviewed: a) Callaway Procedure APA ZZ-00365, Addendum L, "Callaway Lifting Operations," Revision 18; b) Callaway Procedure APA-ZZ-00365, "Callaway Lifting and Rigging Program," Revision 26

Category: Crane Operation **Topic:** Height Limit During Cask Movement

Reference: No Reference Provided

Requirement For single failure proof cranes, the cask height during movement should be sufficiently high to allow for engaging of the brakes during an uncontrolled descent before the load would impact the floor.

Observation: Callaway had placed this requirement into their loading procedures. Procedure HPP-2253-200 contained a Note right above Step 7.7.40 that stated, "The HI-TRAC VW must be maintained greater than 9" above the 2047'-6" deck while not centered over the Cask Loading Pit or Cask Wash Down Pit." The nine inch lift height was conservatively above the manufacturer's recommendations of sufficient height to ensure the main hoist brakes would engage during an uncontrolled lowering event.

Documents Reviewed: a) Holtec Procedure HPP-2253-200 "MPC Loading at Callaway," Revision 9

Category: Crane Operation **Topic:** Hoist Limit Switch Tested Each Shift

Reference: ASME B30.2, Section 2-3.2.4 (a) Published 1976

Requirement At the beginning of each shift, the operator shall try out the upper limit device of each hoist under no-load. Care shall be exercised. The block shall be inched into the limit or run in at a slow speed.

Observation: The Callaway procedure for the cask handling crane listed all of the inspection areas and steps to be performed for daily preoperational testing. Step 5.6.4 (e) of the crane operation procedure tests the upper limit cut-off of the main hoist. This demonstrated that Callaway met the requirements of ASME B30.2, section 2-3.2.4, which required that at the beginning of each shift, the operator shall try out the upper limit device of the hoist under no load.

Documents Reviewed: a) Callaway Procedure OTS-KE-00016, "Operation of the Cask Handling Crane," Revision 21

Category: Crane Operation **Topic:** Qualification For Crane Operator

Reference: ASME B30.2, Sections 2-3.1.2 and 2-3.1.6 Published 1976

Requirement Qualification to operate a cab operated or remote operated crane, requires the operator to pass a written or oral examination and a practical operating examination specific to the type of crane to be operated unless able to furnish evidence of previous qualification and experience. In addition, the operator shall: a) have vision of at least 20/30 Snellon in one eye and 20/50 in the other with or without corrective lenses; b) be able to distinguish colors regardless of their position; c) have sufficient hearing capability for the specific operation with or without hearing aids; d) have sufficient strength, endurance, agility, coordination and reaction speed for the specific operation; e) have evidence of not having physical defects or emotional instability that would interfere with crane operation; and f) not be subject to seizures, loss of control, or dizziness.

Observation: NRC performed an onsite inspection of crane operator qualifications at the Callaway site on August 6, 2015. NRC inspectors reviewed the qualification documents while onsite and returned them to Callaway so that there were no problems with handling personally identifiable information (PII). NRC confirmed the qualifications of the crane operators at Callaway through its review of vertical cask transporter (VCT), HI-PORT, Overhead Crane, Cask Handling Crane Upgrade, and National Commission for the Certification of Crane Operator (NCCO) training course records, among others. All of the crane operators were verified as meeting the requirements listed in ASME B30.2, sections 2-3.1.2 and 2-3.1.6.

Documents Reviewed: a) Various personnel training records for crane operators at the Callaway site (PII)

Category: Crane Operations **Topic:** Maximum Weight of Canister

Reference: FSAR 1040, Section 9.0, Table 3.2.1 Revision 2

Requirement The maximum weight of the transfer cask containing the canister filled with water and fuel (including dynamic loads) that will be lifted by the crane is to be verified to be within the crane's rated capacity.

The handling weights for the Holtec storage system components are provided in Tables 3.2.1 of the FSAR. The user shall implement controls to ensure all critical set points (e.g., lift weights) do not exceed design limits of the specific equipment.

Observation: The licensee had verified that the weight of the Holtec storage system components would not exceed the rated load of the Callaway fuel building crane. Holtec Report No. HI-2146011, Table 7.2 documented the maximum lifted weight during the performance of a HI-STORM UMAX System, loaded at Callaway, would be during the removal of the HI-TRAC VW transfer cask from the spent fuel pool with the neutron water jacket full of water (Case 2 in Table 7.2). Case 2 of Table 7.2 showed a total lift weight of 247,088 pounds (123.5 tons), which was less than the 125-ton rating of the fuel building crane. The individual component weights shown in Table 7.2 were consistent with those in Holtec FSAR.

Documents Reviewed: a) Holtec Report Number HI-2146011, "Cask Handling Weights at Callaway," Revision 1; b) Holtec Report HI-2115090, "Final Safety Analysis Report (FSAR) on the HI-STORM UMAX Canister Storage System," Revision 2

Category: Crane Operations **Topic:** Provisions For Manual Operation

Reference: NUREG 0554, Sections 3.4; 4.9 Published May 1979

Requirement A crane that has been immobilized because of failure of controls or components while holding a critical load should be able to hold the load or set the load down while repairs or adjustments are made. This can be accomplished by inclusion of features that will permit manual operation of the hoisting system and the bridge and trolley transfer mechanisms by means of appropriate emergency devices.

Observation: The American Crane & Equipment Corporation supplied 125-ton single-failure proof crane for Callaway's fuel building included features that permitted manual operation of the hoisting system and the bridge and trolley transfer mechanisms. These features were tested on June 12, 2014 during the Callaway 100% site acceptance test of the crane per Procedure REP-21250-007. Callaway's Engineering group also developed a site procedure that could be utilized to manually lower a suspended load in the event of a crane malfunction. Callaway Procedure OTS-KE-00016, Attachments 4-6 contained steps to allow manual operation to lower a load, manually operate the bridge, and manually operate the trolley.

Documents Reviewed: a) Procedure REP-21250-007, "American Crane & Equipment Corporation Site Load Test," Revision 1; b) Callaway Procedure OTS-KE-00016, "Operation of the Cask Handling Crane," Revision 22

Category:	Dry Run Demonstration	**Topic:**	Fuel Loading and Verification Demonstration
Reference:	CoC 1040, Condition 8.c, d		Amendment 0
Requirement	The dry run shall include selection and verification of specific fuel assemblies to ensure type conformance and the loading of specific assemblies into the canister (using a dummy fuel assembly), including appropriate independent verification.		
Observation:	NRC inspectors observed fuel movement operations in the spent fuel pool (SFP) and assembly placement into multiple MPC slots during Callaway ISFSI dry-run #4 demonstration, August 4-6, 2015. Callaway fuel movers demonstrated the ability to access difficult to reach locations of the SFP and most restrictive areas of the MPC, as situated in the cask loading pit. A walk-through of how the independent verification process would be controlled was also demonstrated during the dry run. Fuel handlers at Callaway fully satisfied the CoC 1040 condition during this preoperational demonstration.		
Documents Reviewed:	a) Callaway Procedure OTS-KE-00012, "Spent Fuel Pool Bridge Crane," Revision 33		

Category:	Dry Run Demonstration	**Topic:**	MPC Pressure Test, Drying, and Helium Backfill
Reference:	CoC 1040, Condition 8.f		Amendment 0
Requirement	The dry run shall include pressure testing, draining, moisture removal (by vacuum drying or forced helium dehydration, as applicable), and helium backfilling. A mockup may be used for this dry-run exercise.		
Observation:	NRC inspectors observed and documented MPC draining, pressure testing, force helium dehydration, and helium backfill activities during Holtec's second dry run demonstration at Callaway on June 2-4, 2015. A part-size mockup was used for these demonstrations, so the time that it took for operations was greatly abbreviated. Holtec successfully demonstrated pressure testing requirements of the MPC and met all of the required dryness and helium backfill levels just as would be required for a full-sized MPC with actual fuel loaded inside.		
Documents Reviewed:	a) Holtec Procedure HPP-2253-300, "MPC Sealing at Callaway," Revision 7		

Category:	Dry Run Demonstration	**Topic:**	MPC Removal from Spent Fuel Pool
Reference:	CoC 1040, Condition 8.e		Amendment 0
Requirement	The dry run shall include remote installation of the canister lid and removal of the canister and transfer cask from the spent fuel pool or cask loading pool.		
Observation:	NRC inspectors observed the remote installation of the MPC lid and removal of the MPC and HI-TRAC transfer cask from the cask loading pit (inside the spent fuel pool) to the cask wash-down area of the fuel building. This activity was demonstrated during dry-run #4, August 4-6, 2015. The licensee utilized Procedure HPP-2253-200 to perform the dry run. Callaway fully satisfied this preoperational criteria in the Holtec UMAX Certificate of Compliance 1040.		
Documents Reviewed:	a) Holtec Procedure HPP-2253-200, "MPC Loading at Callaway," Revision 9		

Category: Dry Run Demonstration **Topic:** MPC Transfer to UMAX

Reference: CoC 1040, Condition 8.g Amendment 0

Requirement The dry run shall include transfer cask of the MPC from the transfer cask to the UMAX VVM.

Observation: Callaway demonstrated MPC transfer operations to the UMAX VVM during dry run #3 on July 14-16, 2015. NRC inspectors verified successful transfer of a dummy MPC-37 canister to the UMAX VVM at Callaway. Holtec followed procedure HPP-2253-400.

Documents Reviewed: a) Holtec Procedure HPP-2253-400, "MPC Transfer at Callaway," Revision 6

Category: Dry Run Demonstration **Topic:** MPC Welding and NDE

Reference: CoC 1040, Condition 8.f Amendment 0

Requirement The dry run shall include canister welding and non-destructive examination (NDE) of the canister lid.

Observation: NRC inspectors observed MPC closure welding and the non-destructive testing operations (visual, liquid dye penetrant, and helium leak check) of those welds during the Holtec UMAX dry-run #1 on May 19-21, 2015. Holtec and its welding contractor PCI successfully demonstrated welding of the MPC closure lid to shell weld, port cap covers, and closure ring during its first dry run demonstration for NRC. In addition, NDE of those welds and helium leak testing operations were observed during this dry run. Callaway met this CoC 1040 requirement.

Documents Reviewed: a) PCI Project Instruction, PI-CNSTR-OP-CAL-H-01, "Closure Welding of Holtec Multi-Purpose Canisters - UMAX," Revision 0; b) PCI General Welding Standard - 1 (GWS-1), Revision 0; c) PCI General Quality Procedure, GQP-9.2, "High Temperature Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 8; d) PCI General Quality Procedure, GQP-9.7, "Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 11; e) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: Dry Run Demonstration **Topic:** Placement of MPC in Spent Fuel Pool

Reference: CoC 1040, Condition 8.a, b Amendment 0

Requirement The dry run shall include moving the MPC and the transfer cask into the spent fuel pool or cask loading pool and preparing the HI-STORM UMAX cask system for fuel loading.

Observation: NRC inspectors observed movement of the MPC and HI-TRAC transfer cask into the spent fuel pool cask loading pit during Callaway's ISFSI dry-run #4 demonstration, August 4-6, 2015. The licensee utilized Procedure HPP-2253-200 to perform the dry run. Callaway fully satisfied the Holtec UMAX CoC 1040 condition during this preoperational demonstration.

Documents Reviewed: a) Holtec Procedure HPP-2253-200, "MPC Loading at Callaway," Revision 9

Category: Dry Run Demonstration **Topic:** Unloading a Canister

Reference: CoC 1040, Condition 8.h Amendment 0

Requirement The dry run shall include HI-STORM UMAX system unloading, including flooding the canister cavity and removing canister lid welds. A mockup may be used for this dry-run exercise.

Observation: NRC observed the demonstration of reflooding of a simulated previously loaded MPC during the second dry-run demonstration at Callaway on June 2-4, 2015. Reflooding of the canister was demonstrated after the drying and backfill dry run was completed. Placement of the MPC and HI-TRAC transfer cask back into the spent fuel pool for unloading was demonstrated during the final dry-run on August 4-6, 2015. These operations were successfully demonstrated as part of Callaway's dry run activities leading up to the first loading during the week of August 24, 2015.

Callaway's contractor, Holtec, completed the MPC cutting dry run on July 16-18, 2015. Holtec performed the MPC lid to shell weld cutting dry run at Holtec Manufacturing Division (HMD) located in Turtle Creek, PA. Callaway personnel were in attendance for this dry run and performed oversight activities throughout the operations. NRC inspectors from headquarters also observed the cutting dry run. Holtec utilized Procedure HPP-2253-500 to perform the cutting demonstration. The cutting activities included boring through the cover plate and the MPC vent/drain port covers. Utilization of a cutting machine to remove the lid to shell weld, while purging the area under the lid with argon, monitoring for hydrogen during the duration of the cutting demonstration, and removal of the MPC lid after the cutting was successful. Ultimately, the ability to core bore through the closure ring and vent/drain port cover plates and cut the MPC lid to shell weld was demonstrated. As a result of the demonstration, a number of procedure enhancements to the implementing procedure HPP-2253-500 were documented on Callaway CAR 201501626, Action 7. In addition, a Holtec International Bulletin (HIB)/Lessons Learned addressing shim installation during lid placement prior to lid to shell welding was to be issued and was also documented on the same CAR. All procedure enhancements were successfully completed prior to Callaway's first loading campaign.

Documents Reviewed: a) Holtec Procedure HPP-2253-500, "MPC Unloading at Callaway," Revision 0 and 7

Category: Emergency Planning **Topic:** Emergency Drills

Reference: 10 CFR Part 50, App E, Section F.1 Published 2015

Requirement The emergency program shall provide for the training of employees and exercising, by periodic drills, of radiation emergency plans to ensure that employees are familiar with their specific emergency response duties.

Observation: No emergency drills had been conducted at the site, specific to the ISFSI. Training had been provided to site personnel on the new emergency action level scheme in April 2015, which included the emergency action levels for the ISFSI. Site personnel conducted drills annually related to plant operations that included all aspects of an emergency response that would be applicable to the ISFSI including fire, medical response, and radiological drills.

Documents Reviewed: a) Callaway Plant Radiological Emergency Response Plan (RERP), Revision 46

Category: Emergency Planning **Topic:** ISFSI Emergency Plan

Reference: 10 CFR 72.32(c) Published 2015

Requirement For an ISFSI that is located on the site of a nuclear power plant licensed for operation, the emergency plan required by 10 CFR 50.47 shall be deemed to satisfy the requirements of this section.

Observation: The licensee was using their Part 50 emergency plan for the ISFSI. Radiological Emergency Response Plan, Table 4-1, "Emergency Action Level (EAL) Classification Matrix," had incorporated the ISFSI and identified an unusual event as the classification for a problem at the ISFSI. Procedure EIP-ZZ-00101, Addendum 2 had incorporated the ISFSI into the emergency action level scheme and identified damage to a loaded cask confinement boundary as the initiating event. This damage could come from different issues which included damage due to a dropped or tipped over cask, explosion at the ISFSI, projectile damage, fire damage, or natural phenomena affecting a cask would classify as an unusual event. Several other EALs could be related to the ISFSI. Due to the type of welded canisters in use, there were no specific EALs related to the ISFSI for radiological releases. However, the site area emergency classification could be reached if radiation levels offsite were measured in excess of 100 mrem. If the levels exceeded 1,000 mrem, a general emergency would be declared. These readings would be based on surveys taken in the field. For a security event, a hostile action in the owner controlled area was an alert. A hostile action within the protected area, including the ISFSI protected area, would be a site area emergency.

Documents Reviewed: a) Callaway Plant Radiological Emergency Response Plan (RERP), Revision 46; b) Callaway Procedure EIP-ZZ-00101 Addendum 2, "Emergency Action Level Technical Bases Document, " Revision 9

Category: Fire Protection **Topic:** Fire Accident Response

Reference: FSAR 1040, Section 12.2.1.3 Revision 2

Requirement Upon detection of a fire adjacent to a loaded HI-STORM UMAX VVM, the ISFSI owner shall take the appropriate immediate actions necessary to extinguish the fire. Following the termination of the fire, a visual and radiological inspection of the equipment shall be performed.

Observation: The NRC inspectors reviewed the licensee's prefire plan and associated strategies and fire response procedure. The inspectors found that the immediate response actions by the fire brigade were incorporated into the prefire plan for the ISFSI pad. If a fire occurred on the heavy haul path, procedure HPP-2253-400, Attachment 8.10 required a continuous attendant equipped with a fire extinguisher who could respond. If that individual could not handle the fire, the fire brigade would be available to respond and have been trained on possible ISFSI transport fires since the ISFSI heavy haul path and pad were entirely within the reactor protected area.

Procedure FPP-ZZ-00007 required a visual and radiological inspection after a fire. There were additional requirements in the Holtec FSAR for actions to take after a fire that were not documented in a site procedure. This observation was captured in CAR 201501626 and the licensee performed a revision to OTO-KC-00001 that incorporated the required actions discussed in the FSAR. The inspectors reviewed the revised procedure and verified the FSAR requirements were adequately incorporated.

The inspectors also reviewed the licensee's EALs and determined that the site did classify a fire associated with the ISFSI causing confinement boundary damage as an Unusual Event.

Documents Reviewed: a) Callaway Procedure FPP-ZZ-00007, "Prefire Strategies," Revision 15; b) Holtec Procedure HPP-2253-400, "MPC Transfer at Callaway," Revision 7; c) Callaway Procedure EIP-ZZ-00101 Addendum 1, "Emergency Action Level Classification Matrix," Revision 4; d) Callaway Procedure OTO-KC-00001, "Fire Response," Revision 14

Category: Fire Protection **Topic:** Fire and Explosion Hazards Analysis

Reference: CoC 1040, App. B.3.4.5; FSAR 1040, Sect 2.2.3.3 Amendment 0/Revision 2

Requirement The potential for fire or explosion shall be addressed, based on site specific considerations. This includes the condition that the onsite transporter fuel tank will contain no more than 50-gallons of diesel fuel while handling a loaded storage cask or transfer cask.

Observation: Explosion hazards were analyzed along the haul path and near the ISFSI in Holtec Report HI-2146196. They included hydrogen tanks and lines, gasoline tanks, and hydrogen delivery trucks since they were adequately determined to be the credible explosion hazards. The assumptions used for explosive hazards in the fire hazards analysis appeared reasonable. No credible explosion hazard exceeded the overpressure needed to tip over the HI-TRAC VW during transport operations or the structural limits of the closure lid for the HI-STORM UMAX at the ISFSI. The fire hazards analysis determined the minimum distance from the ISFSI pad and maximum amount for the hydrogen deliveries that the site had incorporated into procedures to ensure the explosion analysis remained bounding. Since the hydrogen deliveries were not analyzed during transfer using the HI-TRAC VW, the licensee incorporated procedural steps in HPP-2253-400 to stop all hydrogen deliveries during transport operations.

Fire hazards were also analyzed along the haul path and near the ISFSI in Holtec Report HI-2146196. They included diesel tanks and pipes, lube oil tanks and equipment, transformers, gasoline tanks, hydrogen tanks and pipes, delivery trucks of flammable liquids, and Class A flammable materials. The assumptions used for fire hazards in the fire hazards analysis appeared reasonable except that a few buildings near the ISFSI pad did not appear to have been evaluated. These buildings were identified during the NRC inspectors' walk down of the haul path. As a result, the licensee evaluated those buildings and found that they were bounded by other fires in the analysis. No credible fire hazard was found to exceed the acceptable heat input to either the HI-TRAC VW or HI-STORM UMAX closure lid. The fire hazards analysis determined the minimum distance from the ISFSI pad and maximum amount for the flammable liquid deliveries that the site had incorporated into procedures to ensure the fire analysis remained bounding. Since the flammable liquid deliveries were not analyzed for the HI-TRAC on the haul path, the licensee will stop all flammable liquid deliveries during transport operations. The requirement to ensure no deliveries are made during transport operations was verified to be incorporated into site procedures. It is also important to note that the ISFSI pad area was designated as a combustible free zone in site procedures to ensure the analysis remains bounding.

During the review of the 72.212 report, the inspectors reviewed the licensee's analysis of the worst case fire during transport operations to determine whether it was bounded by the analyzed fire in the HI-STORM UMAX FSAR of 50 gallons of diesel fuel from the cask transporter. A piece of equipment named the HI-PORT was used at Callaway to transport the HI-TRAC out of the fuel handling building. Once out of the building, the VCT engaged the HI-TRAC to transport it to the ISFSI pad. The most limiting scenario was when the HI-PORT and VCT were together while the HI-TRAC was being engaged by the VCT. This operation also included the use of an Articulating Boom Lift next to the HI-PORT and VCT. This combined fire hazard included 50 gallons of diesel fuel and 380 gallons of hydraulic fluid from the VCT; 50 gallons of diesel fuel, 130 gallons of hydraulic fluid, and 48 tires with rubber and polyurethane elastomer from the HI-PORT; and a relatively small amount of hydraulic fluid from the boom lift. This fire loading exceeded that of the HI-STORM UMAX FSAR and was specifically evaluated in Holtec Report HI-2156590, "Evaluation of Combined Effect of HI-PORT and VCT Fires on HI-TRAC at Callaway." The evaluation determined that the fuel temperature, MPC component temperatures, and MPC cavity pressure remained well below their limits and the combined fire event did not exceed any FSAR fire accident acceptance criteria. The inspectors determined that the assumptions in the evaluation were reasonable. The inspectors then reviewed the licensee's controls during this operation that would ensure the analysis would remain bounding but did not find it specifically discussed in the applicable procedures. Due to this observation, the licensee updated the procedures to ensure this operation occurred as evaluated and the inspectors verified the revision change to the procedure was adequate. In addition, the inspectors requested the licensee to provide the 72.48 evaluation, since the site-specific fire hazard exceeded what was analyzed in the FSAR. The licensee provided the 72.48 evaluation, which determined this activity did not require NRC prior review and approval. The inspectors found that the 72.48 evaluation was performed adequately.

The inspectors reviewed the Hazards Walkdown Checklist in procedure HPP-2253-400 and performed a walk down of the haul path to ensure adequate controls were in place to limit combustibles along the haul path and all fire and explosion hazards were analyzed. Only the buildings that could contain Class A combustibles or flammable liquids discussed above were found not to have been analyzed, but were ultimately determined to be bounded by other more limiting fire hazards. The inspectors discussed a number of observations with the licensee to clarify and improve the checklist, which were incorporated into a revision of the checklist and associated procedure. The checklist ensured, among other things, that transient combustibles were controlled to adequate distances from the haul route, all "Hot Work" activities near the haul path were suspended, sufficient fire protection equipment was available along the haul route, and there were no fire protection impairments related to the equipment needed to respond to fires along the haul route or at the ISFSI pad during transportation operations.

Documents Reviewed: a) Holtec Procedure HPP-2253-400, "MPC Transfer at Callaway," Revisions 2, 4, 5, and 7; b) Holtec Report HI-2146196, "Evaluation of Plant Hazards at Callaway Energy Center," Revisions 2, 3, and 4; c) Holtec Report HI-2156590, "Evaluation of Combined Effect of HI-PORT and VCT Fires on HI-TRAC at Callaway," Revisions 0 and 1; d) Holtec Report HI-2135677, "Evaluation of Effects of Tracked VCT Fire on HI-STORM FW System," Revision 5; e) Holtec Report HI-2094400, "Thermal Evaluation of HI-STORM FW," Revision 12; f) 72.48 Evaluation titled "MP 14-0014, Dry Fuel Storage Licensing and Operations Documentation," Revision 0; g) 10 CFR 72.212 Evaluation Report "Callaway Plant, Unit 1, Dry Fuel Storage System for Spent Nuclear Fuel Docket 72-1045," Revision 0

Category: Fire Protection **Topic:** Fire Protection Plan

Reference: 10 CFR 50.48(a)(1) Published 2015

Requirement Each operating nuclear power plant must have a fire protection plan that satisfies Criterion 3 of Appendix A to Part 50. This fire protection plan must describe the overall fire protection program for the facility.

Observation: Callaway had incorporated the ISFSI into the applicable fire protection procedures and program documents to ensure it was adequately protected. This included 1) control of combustibles in the vicinity of the ISFSI pad, 2) that transient combustibles were evaluated near the ISFSI, 3) site modifications took into account fire hazards to the ISFSI, 4) delivery of combustible and explosive materials was suspended during cask transport operations, and 5) the quantities of combustible and explosive materials delivered during storage operations were within the limits specified in the site specific fire hazards analysis and Holtec FSAR.

Documents Reviewed: a) Callaway Procedure APA-ZZ-00700, "Fire Protection Program," Revision 20; b) Callaway Procedure APA-ZZ-00741, "Control of Combustible Materials," Revision 27

Category: Fuel Selection/Verification **Topic:** Authorized Contents For Storage

Reference: CoC 1040, Appendix B, Section 2.1.1 Amendment 0

Requirement The HI-STORM UMAX system and MPC-37 is authorized for storage of fuel assemblies, fuel debris, and non-fuel hardware meeting the requirements of Appendix B, Section 2.1.1 and Tables 2.1-1 through 2.1-3.

Observation: The licensee had adequately incorporated the authorized contents for storage requirements into their site procedures. For the initial campaign, the licensee planned to limit loading to intact fuel elements only. No damaged fuel would be loaded for dry storage per the acceptance criteria of Section 3.0 of ETP-ZZ-04020. Section 5.4 of the document provided limits for Callaway storage. Page 165 presented limits for comparison with those of Table 2.1-1 through 2.1-3 of the Certificate of Compliance. Other limits in agreement with the CoC were specified in Section 5.1, Precautions and Limitations, which presented limits on MWD/MTU, heat load per cell, cladding type, maximum initial enrichment, post irradiation cooling time, fuel assembly length and width and weight. Section 5.5 of the procedure documented compliance with Note 1 of

Table 2.1-1 of the CoC. The first canister's fuel assemblies information was reviewed by NRC inspectors and was found to meet requirements of Appendix B, Section 2.1.1 and Tables 2.1-1 through 2.1-3.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04020, "Fuel Selection and Cask Loading for Dry Cask Storage," Revision 0

Category: Fuel Selection/Verification **Topic:** Damaged Fuel Classification

Reference: FSAR 1040, Glossary; ISG-1, Rev. 2 Revision 2

Requirement A damaged fuel assembly is a fuel assembly with known or suspected cladding defects, as determined by review of records, greater than pinhole leaks or hairline cracks, empty fuel rod locations that are not replaced with dummy fuel rods, missing structural components such as grid spacers, whose structural integrity has been impaired such that geometric rearrangement of fuel or gross failure of the cladding is expected based on engineering evaluations, or those that cannot be handled by normal means. Fuel assemblies that cannot be handled by normal means due to fuel cladding damage are considered fuel debris.

Observation: The licensee adequately implemented the damage fuel classification. Damaged fuel was defined in Section 5.4.7 of ETP-ZZ-04020. The section stated that damaged fuel assemblies were those with known or suspected cladding defects, as determined by a review of records, greater than pinhole leaks or hairline cracks, empty fuel rod locations that are not filled with dummy fuel rods, missing structural components such as grid spacers, whose structural integrity had been impaired such that geometric rearrangement of fuel or gross failure of the cladding was expected based on engineering evaluations or that cannot be handled by normal means. Fuel assemblies that cannot be handled by normal means due to fuel failure were considered fuel debris.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04020, "Fuel Selection and Cask Loading for Dry Cask Storage," Revision 0

Category: Fuel Selection/Verification **Topic:** Decay Heat, Burnup & Cooling Time Limits

Reference: CoC 1040, App. B Table 2.1-1, Table 2.3-1 Amendment 0

Requirement Fuel assemblies stored in the HI-STORM UMAX system canister must meet the decay heat, burnup and cooling time limits specified in Appendix B, Table 2.1-1 and Table 2.3-1 of the Certificate of Compliance.

Observation: Callaway Procedure ETP-ZZ-04020, incorporated the decay heat, burnup, and cooling time requirements from the Certificate of Compliance (Appendix B. 2.1 and 2.3 of CoC). Section 5.1 of the Procedure, outlined precautions and limitations for assemblies to be placed in dry cask storage. It was recognized in the procedure that no damaged fuel is to be loaded at this time. In addition, requirements for assembly burnup and heat load per cell limits agreed with limits established in the CoC. Section 5.4 of the procedure, outlined that only fuel assemblies meeting specific limits are approved for storage. Criteria outlined in Section 5.4 for cladding type (Zr), maximum initial enrichment (5 wt %), post irradiation cooling time (equal to or greater than 3 years), fuel assembly width (equal to or less than 8.54 inches) and fuel assembly weight (equal to or less than 2050 pounds) are identical to those presented in Table 2.1-1 of the CoC. Acceptance criteria for fuel assembly length of equal to or greater than 114 inches and equal to or less than 168 inches compared with the CoC limit of equal to or less than 199.2 inches. Fuel assembly decay heat values were determined utilizing the Caskloader computer code developed by the Electrical Power Research Institute (EPRI) to assist utilities in the planning, preparation, and execution of loading spent fuel assemblies and core components into dry fuel storage casks. Calculations for regional loading were made by the licensee to comply with Appendix B Section 2.3, Table 2.3-1, utilizing Append B Figure 2.3-1. Non-fuel hardware decay heat values were utilized for particular storage locations.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04020, "Fuel Selection and Cask Loading for Dry Cask Storage," Revision 0

Category: Fuel Selection/Verification **Topic:** Fuel Loading Error

Reference: CoC 1040, Appendix B, Section 2.2 Amendment 0

Requirement If any loading condition of Appendix B, Section 2.1 is violated, the affected fuel assemblies shall be placed in a safe condition, the NRC Operations Center shall be notified within 24 hrs, and a special report describing the cause of the violation and actions taken to restore compliance and to prevent recurrence shall be submitted to the NRC within 30 days.

Observation: The licensee had requirements in their procedure that noted, if any loading condition is violated, the affected assemblies should be placed in a safe condition and notifications made. Attachment 1 of the APA-ZZ-00520 specified on Item 7, sheet 14 of 24 in sub-item, that the NRC Operation Center will be notified initially within 24 hours if any of the Fuel Specifications or Loading Conditions in Section 2.1 of the HI-STORM UMAX CoC, Appendix B were violated. Sheets 17 and 18 noted that a follow-up notification in the form of a special written report was required within 30 days of initial notification. The report was required to describe the cause of the violation and actions taken to restore compliance and prevent reoccurrence.

Documents Reviewed: a) Callaway Procedure APA-ZZ-00520, "Reporting Requirements and Responsibilities," Revision 44

Category: Fuel Selection/Verification **Topic:** Fuel Shims

Reference: FSAR 1032 Section 1.2.1.1 Revision 3

Requirement The actual length of fuel shims (if required) will be determined on a site-specific and fuel assembly-specific basis.

Observation: Callaway had implemented provisions to ensure adequate shims were installed into the MPCs prior to loading the canisters. Fuel shims were utilized to vertically position fuel assemblies in the canister to ensure the gap between the MPC lid and the top of the fuel insert, or top nozzle of the assembly (with no insert), met the analyzed limits of 1.5 to 2.5 inches. Axial clearance was provided to account for manufacturing tolerances and the irradiation and thermal growth of fuel assemblies. Actual length of the fuel shims were determined based of site-specific and fuel assembly specific bases. Section 7.0 of the procedure ETP-ZZ-0420 provided the applicable instructions. Step 7.3.2 stated that the licensee must ensure that the specified MPC had been loaded with fuel spacers appropriate for the insert type. Step 7.6.2 noted that the full down position of fuel assemblies will vary based on the insert type (No insert, RCCA, or BP/TP/NSA).

Documents Reviewed: a) Callaway Procedure ETP-ZZ-0420, "Fuel Selection and Cask Loading for Dry Cask Storage," Revision 0

Category: Fuel Selection/Verification **Topic:** Material Balance, Inventory, and Records

Reference: 10 CFR 72.72(a) Published 2015

Requirement Each licensee shall keep records showing the receipt, inventory (including location), disposal, acquisition, and transfer of all SNM with quantities specified in 10 CFR 74.13(a)(1).

Observation: The licensee's Special Nuclear Material (SNM) accountability plan was revised to include fuel transferred from the spent fuel pool to Callaway's ISFSI. Details of the SNM accountability plan were presented in Procedure APA-ZZ-00405. A new Item Control Area was created for the ISFSI in Revision 28 of the procedure.

Documents Reviewed: a) Callaway Procedure APA-ZZ-00405, "Special Nuclear Material Control and Accounting Procedure," Revision 28

Category: Fuel Selection/Verification **Topic:** Post Loading Verification

Reference: FSAR 1032, Section 9.2.3.3 Revision 3

Requirement Perform a post-loading visual verification of the assembly identification markings to confirm that the serial numbers match the approved fuel loading pattern.

Observation: The licensee's procedures had incorporated the requirement to perform an independent post-loading visual verification to confirm that the fuel assembly serial numbers matched the loading plan. The post verification requirement was specified in step 7.10 of ETP-ZZ-04020. NRC inspectors observed the licensee perform the post loading verification, utilizing an underwater camera on the first canister loaded during the week of August 24, 2015.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04020, "Fuel Selection and Cask Loading For Dry Cask Storage," Revision 0

Category: General License **Topic:** Evaluation of Effluents/Direct Radiation

Reference: 10 CFR 72.212(b)(5)(iii) & 10 CFR 72.104(a) Published 2015

Requirement The general licensee shall perform a written evaluation prior to use that establishes that the requirements of 10 CFR 72.104 "Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI" have been met. 10 CFR 72.104 requires the annual dose equivalent to any real individual who is located beyond the controlled area must not exceed 25 mrem to the whole body, 75 mrem to the thyroid and 25 mrem to any other critical organ during normal operations and anticipated occurrences,

Observation: The licensee performed an evaluation to ensure that the requirements of 10 CFR 72.104, Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI and showed in Section 5.3 of the 72.212 Report, that the dose equivalent to any individual who is located outside the controlled area was a small fraction of the regulatory limits of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other critical organ. No effluent doses, including thyroid doses, would occur with the welded and sealed Holtec canisters used by the Callaway Energy Center. Though there was not a berm on all sides of the ISFSI, for flood control purposes there were berms on two sides, plant south and plant east that contribute to shielding of direct radiation. Further discussion of calculations associated with the doses to the public are provided under the Category: Radiation Protection and the Topic: Controlled Area Boundary Dose Rate Analysis.

Documents Reviewed: a) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage System for Spent Nuclear Fuel Docket 72-1045," Revision 0; b) Callaway Procedure HPCI-15-05, "Evaluation of Direct Radiation Dose to the Member of the Public from the Independent Spent Fuel Storage Installation," Revision 1

Category: General License **Topic:** Flood Conditions

Reference: CoC 1040, Appendix B, Section 3.4.4 Amendment 0

Requirement Verify that the site analysis for flooding does not exceed the Certificate of Compliance limits of 15 fps water velocity and a height of 125 feet of water.

Observation: The UMAX at the Callaway site was evaluated and verified to not exceed the Certificate of Compliance limits for 15 fps velocity of water and a height of 125 feet of water. Section 5.4.1.3 of the 72.212 Evaluation Report documented that all of Callaway's plant safety-related structures and components are located on a plateau 280 feet or more above maximum flood level. The site is higher than the surrounding terrain so natural streams drain away from the plateau so that isolated local flooding will not occur as a result of a probable maximum precipitation event. The GEI calculation CEC-CS 006-01, concluded that the peak water surface elevations resulting from local intense precipitation event does not exceed critical elevations for the Callaway ISFSI site. Section 5.4.1.7 of the 72.212 Evaluation Report, noted that the ISFSI site is located on a slight plateau with no significantly higher ground within five miles of the site.

The HI-STORM UMAX System is flood resistant as discussed in Section 2.4.7 of the UMAX FSAR. Licensee documents noted that the VVM will withstand a hydraulic head of 125 feet of water submergence. Full or partial submergence of the MPC is not of concern as heat removal is enhanced by the presence of water.

Documents Reviewed: a) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage System for Spent Nuclear Fuel Docket 72-1045," Revision 0; b) Consultant Calculation GEI, CEC-CS 006-01, "Callaway Site Evaluation," Revision 0

Category: General License **Topic:** Initial Compliance Evaluation Against CoC

Reference: 10 CFR 72.212(b)(5) Published 2015

Requirement A general licensee shall perform written evaluations, prior to use and before applying the changes authorized by an amended Certificate of Compliance to a cask loaded under the initial Certificate of Compliance or an earlier amended Certificate of Compliance, which establishes that the cask, once loaded with spent fuel or once the changes authorized by an amended Certificate of Compliance have been applied, will conform to the terms, conditions, and specifications of the Certificate of Compliance or amended Certificate of Compliance listed in 10 CFR 72.214.

Observation: The Callaway 72.212 Evaluation Report evaluated the terms, conditions and specifications in Certificate of Compliance 1040, Amendment 0, and documented that the conditions as set forth had been met at the Callaway site. Section 5.1 of the 72.212 Evaluation Report, provided a detailed comparison of the requirements in the Certificate of Compliance against the procedures and programs established at Callaway. The licensee used a combination of already existing Part 50 programs and procedures and newly developed procedures specifically for the ISFSI.

Vertical Ventilated Modules (VVMs) having a cavity enclosure container (CEC), a cavity enclosure divider shell, a VVM Closure lid, the HI-TRAC VW transfer cask, and the MPC-37 were to be used, at Callaway, to transport and store the pressurized water reactor spent fuel. The MPC-37 canister holds 37 spent fuel assemblies.

Appendix 1 of the 72.212 Evaluation Report provided a detailed list of each of the licensing conditions in the Certificate of Compliance, the technical specifications in Appendix A of the CoC, and the approved contents and design requirements in Appendix B of the CoC and how Callaway complied with these licensing requirements.

License Condition 1 required the licensee to develop written operating procedures for cask handling, loading, movement, surveillance, and maintenance that are consistent with the UMAX FSAR description of these activities. The licensee had developed "pool-to-pad" and other operating procedures that cover all the activities in License Condition 1.

License Condition 2 required that written cask acceptance tests and a maintenance program be established which is consistent with the technical basis in the UMAX FSAR. Compliance with License Condition 2 was demonstrated through Holtec Component Completion Records and CoC's issued for important to safety structures, systems, and components. The required procedures involving Acceptance Criteria and the Maintenance Program for Callaway dry fuel storage operations had been prepared, revised, and issued as necessary.

License Condition 3 required that activities being performed related to structures, systems, and components designated as important to safety be conducted under an NRC approved quality assurance program. Callaway was using their Part 50 approved program for Part 72 activities.

License Condition 4 required that each lift of an MPC or a HI-TRAC VW transfer cask be performed in accordance with existing heavy load requirements and procedures of the licensed facility. Lifts within the Callaway Fuel Building and made by the single failure proof crane were governed by 10 CFR Part 50. Dry Fuel Storage lifts were conducted in accordance with existing heavy loads Procedure APA-ZZ-00365 and other new Dry Fuel Storage heavy load handling procedures which met existing heavy load requirements.

License Condition 5 required that the fuel loaded in the MPC-37 meet the required fuel specification in Appendix B of the Certificate of Compliance 1040. During the NRC inspection, a detailed review of the licensee's program related to fuel selection was completed to verify that processes and procedures had been put in place by the licensee to ensure that only spent fuel consistent with Appendix B of CoC 1040 would be selected for storage. More detail related to selection of the spent fuel is found in the Inspector Notes of this report under the Category "Fuel Selection and Verification."

License Condition 6 required that features and characteristics for the site or system must be in accordance with Appendix B of the CoC. A discussion of each of the design features in Appendix B were discussed in Appendix 1, Table 3 of the 72.212 Evaluation Report. References were often provided to various Callaway procedures and documents to show compliance with the design features listed in Appendix B.

License Condition 7 discussed making changes to the Certificate of Compliance. Only Holtec can make requests to the NRC to change CoC 1040, since they were the certificate holder. Callaway was a general licensee, and therefore cannot make any change requests directly to the NRC.

License Condition 8 lists the required pre-operational testing and training exercises for the UMAX system prior to the first actual use of the storage system. Callaway had completed all the required testing and training exercises. Details related to each of these can be found in the Inspector Notes of this inspection report under the Category "Dry Run Demonstration."

License Condition 9 authorized use of the Holtec HI-STORM UMAX Canister Storage System as a general license if the user possessed a Part 50 license. Callaway will use the UMAX system as a general license licensee and currently holds a Part 50 reactor license for the single unit Callaway Plant under Docket Number 50-483.

The 72.212 Evaluation Report, Appendix 1, Table 2, CoC Appendix A – Technical Specifications evaluated the requirements of the Callaway dry fuel storage program against the technical specifications in Appendix A of the Holtec 1040 license. Each of the technical specification requirements in the CoC, Appendix A were evaluated. Table 2 addressed and discussed each of the technical specification requirements and when required, referenced where the requirement had been incorporated into the Callaway procedures.

The requirements in the CoC, Appendix B for the approved content and design features were compared to the Callaway dry fuel storage program and documented in the 72.212 Evaluation Report, Appendix 1, Table 3, CoC Appendix B – Approved Contents and Design Features. Each of the applicable requirements from Appendix B of the CoC were shown to be incorporated into Callaway procedures or, for site conditions that were required to be met, Callaway had performed the necessary analysis to show compliance and referenced the analysis document in the table. Many of the table sections also referenced back to specific sections of the main body of the 72.212 Evaluation Report.

Documents Reviewed: a) Callaway Plant Updated Final Safety Analysis Report (UFSAR), The Callaway UFSAR has two parts, the UFSAR-SP for the Standard Plant and the UFSAR-SA for the Site Addendum, Dated February 2014; b) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage for Spent Nuclear Fuel," Revision 0; c) Certificate of Compliance 1040, "Holtec International HI-STORM UMAX Canister Storage System," Amendment 0; d) Holtec Report No. HI-2115090, "Final Safety Analysis Report for the HI-STORM UMAX Canister Storage System," Revision 2; e) Callaway Letter to NRC UNLNRC-06180 Subject: Notification Pursuant to 10 CFR 72.140(d) of Intent to Apply Previously Approved Quality Assurance Program to Independent Spent Fuel Storage Installation (ISFSI) at Callaway Plant, Unit 1, dated February 13, 2015

Category: General License **Topic:** Initial Compliance Evaluation Against FSAR

Reference: 10 CFR 72.212(b)(6) Published 2015

Requirement The general licensee shall review the FSAR referenced in the Certificate of Compliance or amended Certificate of Compliance and the related NRC Safety Evaluation Report, prior to use of the general license, to determine whether or not the reactor site parameters, including analysis of earthquake intensity and tornado missiles, are enveloped by the cask design basis considered in these reports. The results of this review must be documented in the evaluation made in 10 CFR 72.212(b)(5).

Observation: The licensee documented the required written evaluations in the 72.212 Evaluation Report as Section 5.4, "10 CFR 72.212(b)(6) Reactor Site Parameters Review of UMAX FSAR and SER." Section 5.4 included site specific analysis of fires and explosions, tornados, floods, hurricanes and extreme winds, earthquakes, lightning, burial under debris, environmental temperatures, and snow/ice. Each topical area was reviewed against the Callaway Updated Final Safety Analysis Report (UFSAR) or other site specific documents. The licensee found that they were bounded by the UMAX FSAR in all areas except for fire, explosions, and tornados. As such, Callaway performed a 72.48 evaluation and additional calculations to show the design basis for each area was still met and did not require Callaway to have the Certificate holder to request a license amendment (See Topic Safety Reviews).

Section 5.2.2 of the 72.212 report documented the review of the ISFSI stability including seismic evaluations. The ISFSI stability was evaluated by examining the liquefaction potential, settlement, bearing capacity, and potential for sliding and overturning. The design base earthquake event for the Callaway site was evaluated to not create an issue with MPC retreivability, subcriticality, and the confinement boundary would not be compromised. Callaway Part 50 UFSAR Figure 3.7(B)-1 and Figure 3.7(B)-2 described the design basis earthquake of the Callaway site as a horizontal and vertical zero period accelerations (ZPAs) of 0.20g for both directions. The ground surface horizontal and vertical ZPA used to seismically analyze the UMAX structure in Section 3.4.4.1.2 of the HI-STORM UMAX FSAR ranged from values of 0.539g to 1.008g, with peak accelerations up to 4.040g. Callaway's design basis earthquake was bounded by the UMAX design basis by a considerable margin.

NRC inspectors reviewed the Callaway's 72.212 evaluation report and supplemental evaluations which demonstrated the site parameters for all environmental conditions analyzed were enveloped by the HI-STORM UMAX system design bases. No findings or issues were identified during this review.

Documents Reviewed: a) 72.48 Evaluation Log No. 15-01, "MP 14-0014, Dry Fuel Storage Licensing and Operations Documentation," Revision 0; b) Holtec Report HI-2146196, "Evaluation of Plant Hazards at Callaway Energy Center," Revisions 2, 3, and 4; c) Holtec Report HI-2156590, "Evaluation of Combined Effect of HI-PORT and VCT Fires on HI-TRAC at Callaway," Revisions 0 and 1; d) Holtec Report HI-2135677, "Evaluation of Effects of Tracked VCT Fire on HI-STORM FW System," Revision 5; e) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage System for Spent Nuclear Fuel Docket 72-1045," Revision 0

Category: General License **Topic:** Initial Evaluation Against Part 50 License

Reference: 10 CFR 72.212(b)(8) Published 2015

Requirement Prior to use of the general license, determine whether activities related to storage of spent fuel involve a change in the facility technical specifications or require a license amendment for the facility pursuant to 10 CFR 50.59(c). Results of this determination must be documented in the evaluation made in 10 CFR 72.212(b)(8).

Observation: Activities related to the storage of spent fuel under the Callaway 10 CFR Part 72 general license were reviewed in accordance with 10 CFR 50.59 for the required modifications and procedure changes, and none of these reviews resulted in NRC approval being required. Callaway developed Modification Package MP14-0014, Dry Fuel Storage Licensing and Operations Documentation to assess and authorize the dry fuel storage operations at Callaway Unit 1. The purpose of MP 14-0014 was to address all operations for loading spent fuel assemblies into an MPC, drying and sealing of the MPC, transport of the loaded transfer cask to the Callaway UMAX ISFSI, transfer of the loaded MPC from the transfer cask into the UMAX, storage of the spent fuel in the UMAX system at Callaway, and all unloading operations. Other modification packages required for ISFSI implementation, including Callaway ISFSI installation, haul path construction, security modifications, and upgrade of the cask handling crane in the fuel building were located in different modification packages that were listed in Table 5.5 of Callaway 72.212 Evaluation Report. NRC inspectors reviewed many of listed modification packages throughout the construction of the ISFSI, dry run inspections, and first loading inspection. No findings were identified regarding Callaway's 50.59 reviews.

Documents Reviewed: a) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage for Spent Nuclear Fuel," Revision 0; b) 50.59 Screen MP14-0014, "Dry Fuel Storage Licensing and Operations Documentation," Revision 0

Category: General License **Topic:** ISFSI Decommissioning Funding Report

Reference: 10 CFR 72.30 (b) Published 2015

Requirement Each licensee must submit for NRC review and approval a decommissioning funding plan prior to loading fuel into an ISFSI.

Observation: Callaway provided their draft letter to the NRC inspectors for the ISFSI Decommissioning Funding Report to be submitted to the NRC before their initial loading campaign. CAR 201306666 was tracking this submission with a due date before the initial load commenced. The funding plan letter was ultimately submitted prior to the first loading campaign to the NRC on August 17, 2015 (ML15229A127).

Documents Reviewed: a) Letter from Callaway to NRC, "Docket Numbers 50-483 and 72-1045 Callaway Plant Unit 1 Union Electric Co. Renewed Facility Operating License NPF-30, ISFSI Decommissioning Funding Plan," Dated August 17, 2015 (ML15229A127); b) Draft 10 CFR 72.30 ISFSI Decommissioning Cost Estimate

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Category: General License **Topic:** Limiting Site Temperatures

Reference: CoC 1040, Appendix B, Section 3.4.1; 3.4.2 Amendment 0

Requirement The maximum average yearly temperature at the site shall be verified as 80 degrees F. The temperature extremes, averaged over a 3-day period, shall be greater than -40 degrees F and less than 125 degrees F.

Observation: The Callaway site is below the maximum average yearly temperature of 80 degree F and within the -40 to 125 degree F temperature extremes, averaged over any 3-day period. The Callaway UFSAR-SA (Site Addendum), Section 2.3.2.1.2.2, "On-Site Temperatures," stated that the annual average temperature in the site area was approximately 55.6°F, and was therefore enveloped by the HI-STORM UMAX Canister Storage System design basis. Table 2.3.6 of the HI-STORM UMAX FSAR specified a design basis normal soil temperature (bounding annual average) not to exceed 77°F. Chapter 11, Page 11.10 of the 2008 ASHRAE Handbook - HVAC Systems and Equipment (Reference f), stated that the average annual air temperature should be used to approximate the average annual soil temperature. As stated above, the annual average air temperature at the Callaway site was approximately 55.6°F, which was less than the 77°F requirement specified in the HI-STORM UMAX FSAR for annual average soil temperature.

The lower bound off-normal temperature limit for the HI-STORM UMAX in the HI-STORM UMAX FSAR, Table 2.3.6, was defined as a 3-day average minimum ambient temperature of -40°F. Callaway UFSAR-SA, Table 2.3-23, showed a lowest extreme minimum temperature of -26°F. Therefore, the Callaway minimum temperature met the -40°F 3-day average minimum design basis temperature limit in the HI-STORM UMAX FSAR.

Table 2.3-22 of the Callaway UFSAR-SA showed 116°F as the highest extreme maximum temperature. This was bounded by the extreme accident level ambient temperature limit of 125°F for which the HI-STORM UMAX VVM was designed.

Documents Reviewed: a) Holtec Report No. HI-2115090, "Final Safety Analysis Report on the HI-STORM UMAX Canister Storage System (HI-STORM UMAX FSAR), Docket 72-1040," Revision 2; b) Callaway Plant Updated Final Safety Analysis Report (UFSAR), The Callaway UFSAR has two parts, the UFSAR-SP for the Standard Plant and the UFSAR-SA for the Site Addendum, dated February 2014; c) Holtec Procedure, HPP-2253-400 "MPC Transfer at Callaway," Revision 2; d) Holtec Procedure HPP-2253-500, "MPC Unloading at Callaway," Revision 1; e) Certificate of Compliance 1040 HI-STORM UMAX Appendix B Section 3.4.1 and 3.4.2, Amendment 0; f) ASHRAE Handbook, "HVAC Systems and Equipment," 2008 Edition

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Category: General License **Topic:** Program Review - RP, EP, QA, and Training

Reference: 10 CFR 72.212(b)(10) Published 2015

Requirement The general licensee shall review the reactor emergency plan, quality assurance program, training program, and radiation protection program to determine if their effectiveness is decreased and, if so, prepare the necessary changes and seek and obtain the necessary approvals.

Observation: The Callaway Part 50 emergency plan, quality assurance program, training program, and radiation protection program were evaluated for any potential decreases in their effectiveness associated with the implementation of the dry fuel storage operations and equipment. Callaway had revised the Callaway Part 50 Radiological Emergency Response Plan consistent with NEI-99-01, Methodology for Developing Emergency Action Levels. A new ISFSI Emergency Action Level had been incorporated into their emergency program and implementing procedures. Callaway had revised their 10 CFR 50 Appendix B Operating Quality Assurance Manual to include dry fuel storage activities in accordance with 10 CFR 72. Callaway had applied their Training Program, the associated appendices, and training manuals to dry fuel storage activities. Callaway training program relied on Holtec's approved training program for training on pool-to-pad procedures and operations. The remaining training areas, such as, fuel handling, 72.48 reviews, ISFSI quality assurance, ISFSI emergency plan, ISFSI routine Technical Specification surveillances, and ISFSI maintenance of important-to-safety equipment would be implemented under the Callaway training program.

Callaway reviewed and revised the Callaway Radiation Protection Program and implementing procedures to verify it applies to and adequately controls ISFSI and dry fuel storage activities. Existing procedures had been reviewed and revised to ensure posting requirements, access control, survey requirements, and personnel and environmental monitoring are applied to ISFSI activities consistent with 10 CFR Part 20 and Part 72 requirements. Additionally, numerous new ISFSI radiation protection procedures were developed to implement specific dry fuel storage radiological requirements.

Documents Reviewed: a) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage for Spent Nuclear Fuel," Revision 0; b) Callaway Plant 10 CFR 50.47 Radiological Emergency Response Plan, Revision 46; c) Callaway 10 CFR 50 Appendix B Operating Quality Assurance Manual (OQAM), Revision 31; d) Callaway Procedure APA-ZZ-00925, "Training and Qualification of Plant Personnel," dated 2015

Category: General License **Topic:** Revisions to 72.212 Analysis

Reference: 10 CFR 72.212(b)(7) Published 2015

Requirement The general licensee shall evaluate any changes to the written evaluations required by 10 CFR 72.212(b)(5) and 10 CFR 72.212(b)(6) using the requirements of 10 CFR 72.48(c). A copy of this record shall be retained until spent fuel is no longer stored under the general license issued under 10 CFR 72.210.

Observation: The 10 CFR 72.212 Evaluation Report, Section 4.0 stated that Callaway's 72.212 report would be reviewed, and revised if necessary, at a minimum before each dry fuel storage campaign to identify the applicable CoC amendment, FSAR revision, and any changes to the MPC model, fuel loading requirements, or VVM design changes to be used at the ISFSI. Additionally, the changes would be handled in accordance with 10 CFR 72.212(b)(7) to perform an written evaluation through the 72.48 process.

Documents Reviewed: a) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage System for Spent Nuclear Fuel Docket 72-1045," Revision 0

Category: General License **Topic:** Storage Cask Blocked Inlet or Outlet Air Vents

Reference: CoC 1040, Appendix B, Section 3.4.9 Amendment 0

Requirement For those users whose site specific design basis includes an event that results in blockage of the storage cask inlet or outlet air vents for an extended period of time longer than the completion time in LCO 3.1.2 (i.e. 64 hours for heat loads less than or equal to 28.74 kW and 24 hours for heat loads greater than 28.74 kW), an analysis may be performed to demonstrate adequate heat removal for the duration of the event. If the analysis is not performed or adequate heat removal cannot be verified, alternate methods of cooling must be established.

Observation: The Callaway ISFSI pad had been designed and located such that flooding and burial due to debris would not occur. The 72.212 Evaluation Report, Section 5.4.1.3 "Flooding" and Section 5.4.1.7 "Burial under Debris" discussed the features of the ISFSI pad that made these events very unlikely. The ISFSI pad was located on nearly a level plateau with elevations ranging from 830 to 850 feet. The elevation of the flood plain of the Missouri River nearest the site is about 525 feet with a Probable Maximum Flood level at elevation 559 feet. Flooding of the Missouri River would never reach the ISFSI. The elevation of the Callaway site is higher than the surrounding terrain and since well-developed natural streams drain the plateau, isolated local flooding would not occur on the Callaway site. Even when due to a severe event such as the Probable Maximum Precipitation.

The Callaway ISFSI is not located in the vicinity of unstable slopes. Section 2.7, Landslides, in Calculation HI-2146196, Evaluation of Plant Hazards at Callaway Energy Center, noted that Section 2.3.2.2.1 of the Callaway FSAR-SA, described the Callaway Plant and ISFSI site as being located on a slight plateau with no significantly higher ground within 5 miles of the site. Therefore, the site topography precluded the possibility of a landslide hazard that could collapse and surround a HI-STORM UMAX VVM. Calculation HI-2146196 Section 2.2, Fall Hazards, stated that there were no structures in the vicinity of the Callaway ISFSI that could collapse and surround a HI-STORM UMAX VVM. The controlled area around the Callaway ISFSI precluded the close proximity of substantial amounts of vegetation. Therefore, a burial under debris accident affecting the Callaway ISFSI VVMs was not an anticipated event.

For the Callaway ISFSI, HI-STORM UMAX CoC Appendix B, Approved Contents and Design Features Subsection 3.4.12, required performance of an analysis or evaluation if the site-specific design basis includes an event that resulted in the blockage of any HI-STORM UMAX inlet or outlet air duct for an extended period of time and provisions for alternate means of cooling be established if the fuel cladding short term temperature cannot be demonstrated to be met or if the analysis or evaluation was not performed.

As described above, flooding was not an issue for the Callaway ISFSI, and the 72.212 report concluded that the burial-under-debris accident event does not affect the safe operation of the HI-STORM UMAX Canister Storage System, if the blockage was removed in the Appendix A Technical Specification 3.1.2 specified time period. Callaway Procedure OSP-ZZ-00001 implemented this Technical Specification requirement. Therefore, Subsection 3.4.12 did not apply to the Callaway ISFSI.

Documents Reviewed: a) Callaway Plant Updated Final Safety Analysis Report (UFSAR), The Callaway FSAR has two parts, the UFSAR-SP for the Standard Plant and the UFSAR-SA for the Site Addendum, Dated February 2014; b) Holtec Calculation HI-2146196, "Evaluation of Plant Hazards at Callaway Energy Center," Revision 4; c) Certificate of Compliance 1040 HI-STORM UMAX Appendix B Section 3.4.12, Amendment 0; d) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage System for Spent Nuclear Fuel Docket 72-1045," Revision 0

Category: Heavy Loads **Topic:** Closure Lid Lift Lugs Inspection

Reference: FSAR 1040 Section 10.4.1 Revision 2

Requirement Prior to each MPC loading, closure lid lift lugs examination shall be inspect for indications of overstress such as cracks, deformation, wear marks, corrosion, ect.

Observation: The Holtec CoC 1040 FSAR requirement for VVM closure lid lifting lug inspection was placed into Callaway's Procedure ETP-ZZ-04021 in Step 7.1.20. This requirement was adequately placed into Callaway's procedure to be completed prior to each loading of an MPC.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04021, "ISFSI Loading Campaign Performance – IPTE," Revision 1

Category: Heavy Loads **Topic:** Licensed Facility Heavy Loads Requirements

Reference: CoC 1040, License Condition 4 Amendment 0

Requirement Each lift of a canister, transfer cask, or storage cask must be made in accordance with the existing heavy loads requirements and procedures of the licensed facility at which the lift is made. A plant specific review (under 50.59 or 72.48, if applicable) is required to show operational compliance with existing plant specific heavy loads requirements.

Observation: The heavy lifts and crane operations associated with the dry cask storage operations were performed in accordance with the plant's maintenance department procedures for all heavy lifting activities in and outside of the plant. The licensee's 50.59 screen that was performed on use of the Holtec equipment and the ISFSI operations documented that reviews and evaluations were performed to ensure all activities were in compliance with the Callaway Lifting and Rigging Program.

The licensee's crane was rated to 125-tons. The maximum lift weight during the dry cask storage operations was calculated at approximately 123.5 tons. The licensee performed a 50.59 evaluation to determine if the seismic and structural analyses performed by Holtec met the Callaway Part 50 Updated Final Safety Analysis Report (UFSAR) requirements for the plant. The conclusion of the 50.59 evaluation determined that the analysis performed by Holtec was within the bounds of the Part 50 UFSAR and utilized the site's approved methodologies.

Documents Reviewed: a) 50.59 Screen MP 14-004, "Dry Fuel Storage Licensing and Operations Documentation (Heavy Loads Review)," Revision 0

Category: Heavy Loads **Topic:** Procedures

Reference: NUREG 0612, Section 5.1.1 (2) Published July 1980

Requirement Procedures should be developed to cover load handling operations for heavy loads that are or could be handled over or in proximity to irradiated fuel or safe shutdown equipment. The procedures should include: a) identification of the required equipment; b) inspections and acceptance criteria required before movement of the load; c) the steps and proper sequence to be followed in handling the load; d) defining the safe load path; and e) special precautions.

Observation: The procedures used at Callaway that embody the requirements of NUREG 0612 for a safe load path were implemented into Callaway's procedures for lifting operations, operation of the cask handling crane, and MPC loading. Both Callaway and Holtec had developed procedures that covered load handling operations for heavy loads in close proximity to irradiated fuel and reactor safe shutdown equipment. The procedures included identifying the safe load path, special precautions, and the identification of required equipment, inspection requirements, and proper rigging sequence to observe when handling a load.

Documents Reviewed: a) Callaway Procedure APA-ZZ-00365, Addendum L, "Callaway Lifting Operations," Revision 18 b) Callaway Procedure OTS-KE-00016, "Operation of the Cask Handling Crane," Revision 22; c) Holtec Procedure HPP-2253-200, "MPC Loading at Callaway," Revision 9

Category: Heavy Loads **Topic:** Safe Load Paths

Reference: NUREG 0612, Section 5.1.1 (1) Published July 1980

Requirement Safe load paths should be defined for the movement of heavy loads to minimize the potential for heavy loads, if dropped, to impact irradiated fuel in the reactor vessel and in the spent fuel pool, or to impact safe shutdown equipment. The path should follow, to the extent practical, structural floor members, beams, etc., such that if the load is dropped, the structure is more likely to withstand the impact.

Observation: Callaway had satisfied the requirement that a safe load path be established as required by NRC NUREG 0612, Section 5.1.1 (1). Callaway's cask handling crane procedure, OTS-KE-00016, Attachment 1, clearly delineated the safe load and travel path for the cask handling crane that would apply when moving the transfer cask. The allowed load path showed exclusion areas for both the main hoist and the auxiliary hoist. The load path protects critical safety systems from being impacted in the event of a load drop scenario.

Documents Reviewed: a) Callaway Procedure OTS-KE-00016, "Operations of the Cask Handling Crane," Revision 22

Category: Heavy Loads **Topic:** Site Temperature Limit for Cask Handling

Reference: CoC 1040, Appendix B, Section 3.4.11 Amendment 0

Requirement Loading, transport, and unloading operations shall only be conducted with working area ambient temperatures of 0 degrees F or higher.

Observation: Holtec's MPC transfer procedure required that the ambient temperature for VCT operation be between 0 and 120 degrees F. This matched the requirements of CoC 1040, Appendix B, Section 3.4.11, which required that loading, transport, and unloading operations shall only be conducted when the work area ambient temperature is 0 degrees F or higher.

Documents Reviewed: a) Holtec Procedure HPP-2253-400, "MPC Transfer at Callaway," Revision 6; b) Holtec Procedure HPP-2253-500, "MPC Unloading at Callaway," Revision 5

Category: Heavy Loads **Topic:** Transporter Initial Acceptance Testing

Reference: NUREG 0554, Section 8.2 Published May 1979

Requirement After the 125% static load test, the crane should be given a full performance test with 100% of the maximum critical load attached, for all speeds and motions for which the system is designed. This should include verifying all limiting and safety control devices.

Observation: NRC inspectors reviewed purchase specifications and accepting testing documentation to verify completion of the transporter load testing requirements. According to documents reviewed by NRC, after the 125% static load test was performed, the VCT was given a performance test with a load slightly over its 100% rated capacity, 415,000 lbs. The 100% performance test included verifying the operation of the lift booms, crawler, emergency stop function, measurement of general clearances, VCT travel, redundant drop protection, and lowering of the load using the emergency hydraulic pump. The test procedure and results met all applicable safety requirements for heavy loads and single failure proof lifting devices.

Documents Reviewed: a) Holtec Procedure HSP-199, "VCT Factory Acceptance Test Procedure," dated April 9-10, 2015

Category: Heavy Loads **Topic:** Transporter Initial Acceptance Testing

Reference: NUREG 0554, Section 8.2 Published May 1979

Requirement The VCT should be static load tested at 125 percent of the maximum critical load. The test should be conducted at all positions generating maximum strain in the bridge and trolley structures and other positions as recommended by the designer or manufacturer.

Observation: The VCT delivered to Ameren for use in their fuel loading campaign was static load tested with a weight of 519,630 lbs., just above 125% of the rated load of 415,000 lbs. This load was held for ten minutes at a height of 1 inch. The acceptance test met the applicable requirements.

Documents Reviewed: a) Holtec Procedure HSP-199, "VCT Factory Acceptance Test Procedure," dated April 9 - 10, 2015

Category: Heavy Loads **Topic:** VCT Transportation Evaluation

Reference: CoC 1040, Tech Spec. A.5.2 Amendment 0

Requirement Between the fuel building and the ISFSI pad, The Transfer Cask, when loaded with spent fuel, may be lifted to and carried at any height necessary during transport operations and MPC transfer, provided that a) The metal body and any vertical columns of the lifting equipment are designed to comply with stress limits of ASME Section III, Subsection NF, Class 3 for linear structures and all vertical compression loaded primary members satisfy the buckling criteria of ASME Section III, Subsection NF; b) the horizontal cross beam and any lifting attachments used to connect the load to the lifting equipment were designed, fabricated, operated, tested, inspected, and maintained in accordance with applicable sections and guidance of NUREG-0612, Section 5.1 and ANSI N14.6; and c) the lifting equipment has redundant drop protection features which prevent uncontrolled lowering of the load.

Observation: The Vertical Cask Transporter (VCT) steel load bearing members were designed to comply with the stress limits of ASME Section III, Subsection NF, Class 3 for linear structures, including vertical compression loaded primary members, as specified in Holtec PS-1120, the VCT purchase specification. PS-1120 required that the VCT be designed for both static and dead loads and dynamic seismic loads and invoked the guidance of NUREG-0612, including Section 5.1.6. PS-1120 required that the cross beams and lifting attachments met the stress limits of ANSI N14.6. The VCT employed redundant drop protection features as specified in the purchase specification. The aforementioned features show that the VCT in use at Callaway met the stress limits and compression buckling requirements of ASME Section III, Subsection NF; the cross beam meets the design requirements of NUREG-0612, and the applicable requirements of ANSI N14.6; and the VCT had redundant drop protection features to prevent uncontrolled lowering of a load.

Documents Reviewed: a) Callaway Dry Storage Project 10 CFR 72.212 Evaluation Report, Revision 0; b) Holtec PS-1120, "Purchase Specification for the Vertical Cask Transporter," Revision 6

Category: Loading Operations **Topic:** Canister Lid Fit Test

Reference: FSAR 1032, Table 10.1.1 Revision 3

Requirement As part of the Holtec inspection and test acceptance criteria, the canister lid, closure ring, and vent and drain port cover plates shall be fit tested prior to canister operation.

Observation: The licensee had incorporated the Holtec FW FSAR requirements into two procedures to perform the required fit tests for the canister lid, closure ring, and vent and drain port cover plates prior to placing the MPC into the spent fuel pool. The licensee utilized Procedures ETP-ZZ-04021 and HPP-2253-100 to perform the fit tests prior to placing the MPC into the spent fuel pool.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04021, "ISFSI Loading Campaign Performance - IPTE," Revision 1; b) Holtec Procedure HPP-2253-100, "MPC Pre-operational Inspection," Revision 3

Category: <u>Loading Operations</u> **Topic:** <u>Cask System Annual Maintenance</u>

Reference: FSAR 1040, Tables 10.4.1 and 10.4.2 Revision 2

Requirement The following cask system maintenance shall be performed annually, or prior to use if out of service for greater than 1 year: a) UMAX VVM in-service inspection, b) ISFSI pad inspection, c) UMAX VVM external surface visual examination, d) UMAX VVM inspection of visual markings, and e) HI-TRAC VW pressure relief valve calibration.

Observation: The licensee had incorporated the UMAX FSAR requirements into three annual Preventive Maintenance procedures (PMs) to perform the required UMAX VVM in-service inspection, ISFSI pad inspection, UMAX VVM external surface visual examination, UMAX VVM inspection of visual markings, and HI-TRAC VW pressure relief valve calibration annually, or prior to use if out of service for greater than one year. The licensee utilized PM1008323 to perform the UMAX VVM in-service inspection, UMAX VVM external surface visual examination, UMAX VVM inspection of visual markings, and to perform the ISFSI pad inspection. The licensee utilized PM1008325 to perform the HI-TRAC VW pressure relief valve calibration.

Documents Reviewed: a) Callaway Procedure PM1008323, "UMAX and ISFSI pad maintenance," Revision 0; b) Callaway Procedure PM1008325, "HI-TRAC VW pressure relief valve calibration," Revision 0

Category: <u>Loading Operations</u> **Topic:** <u>Cask System Inspections Prior to Use</u>

Reference: FSAR 1040, Table 10.4.1 Revision 2

Requirement The following HI-STORM UMAX areas shall be inspected prior to MPC installation: a) CEC cavity visual inspection; b) divider shell visual inspection; c) closure lid examination.

Observation: The licensee had incorporated the UMAX FSAR requirements into their procedures to perform the required inspections prior to MPC loading for; the CEC cavity visual inspection, divider shell visual inspection, and closure lid examination. The licensee utilized Procedure ETP-ZZ-04021 for all three inspections. Procedure ETP-ZZ-04021 contained the inspection requirements listed in FSAR 1040 Table 10.4.1, HI-Storm System Maintenance Program Schedule, for all three components.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04021, "ISFSI Loading Campaign Performance - IPTE," Revision 1

Category: <u>Loading Operations</u> **Topic:** <u>Fuel Cladding Not Exposed to Air</u>

Reference: CoC 1040, Appendix B, Section 3.4.13 Amendment 0

Requirement Procedures and/or mechanical barriers shall be established to ensure that during loading operations (and unloading) that either the fuel cladding is covered by water or the canister is filled with an inert gas.

Observation: This criteria was met at Callaway. Use of special equipment and procedures ensured the fuel was not exposed to air during loading operations. Procedures for loading and unloading dry fuel storage canisters at Callaway all included a caution statement to ensure that the water level in the canister was not lowered below the top of the fuel cladding to avoid exposing fuel to the atmosphere, to prevent oxidation and potential fuel damage. In this regard, Holtec/Callaway had established procedures which ensured that during loading operations that either the fuel cladding was covered by water or the canister was filled with an inert gas. Special equipment such as the "dip tube" and flow meters ensured that less than 50 gallons of water would be removed to support welding operations while also preventing the fuel from being exposed to air.

Documents Reviewed: a) Holtec Procedures HPP-2253-200, "MPC Loading at Callaway," Revision 9; b) Holtec Procedure HPP-2253-500, "MPC Unloading at Callaway," Revision 4

Category: Loading Operations **Topic:** Handling Damaged Fuel Containers

Reference: FSAR 1032, Sections 2.1.3 and 6.4.4.1 Revision 3

Requirement Damaged fuel assemblies and fuel debris shall be loaded into damaged fuel containers (DFCs) prior to being loaded into the canister.

Observation: Damaged Fuel Containers were not to be used during the initial loading campaigns. Section 3.0 of the Callaway Procedure ETP-ZZ04020 provided the Acceptance and Functional Criteria for loading operations. The procedure stated that only fuel assemblies meeting the requirements of the HI-STORM, UMAX Certificate of Compliance for undamaged assemblies were to be loaded into spent fuel canisters.

Documents Reviewed: a) Callaway Procedure ETP-ZZ04020, "Fuel Selection and Cask Loading for Dry Cask Storage," Revision 0

Category: Loading Operations **Topic:** MPC-37 Boron Concentration

Reference: CoC 1014, Tech Spec A.3.3.1 and associated tables Amendment 0

Requirement The boron concentration in the canister shall meet the limits specified in Technical Specification 3.3.1 for the applicable canister model and the most limiting fuel assembly array and class. The boron concentration must be verified within required limits using two independent measurements taken within four hours of filling the canister with water, and every 48 hours thereafter while fuel and water are in the canister.

Observation: The boron concentration sampling requirements specified in the Technical Specification were placed in the implementing procedures for ISFSI loading operations at Callaway. Callaway's loading and unloading procedures HPP-2253-200 and HPP-2253-500 both contained the appropriate steps to sample for boron concentrations when loading fuel assemblies, adding water from the pool during hydrostatic tests, and prior to MPC alternate cooling operations.

Documents Reviewed: a) Holtec Procedure HPP-2253-500 "MPC Unloading at Callaway," Revision 7; b) Holtec Procedure HPP-2253-200 "MPC Loading at Callaway," Revision 9

Category: Loading Operations **Topic:** Pressure Relief Valves

Reference: FSAR 1032, Table 9.1.1 Revision 3

Requirement Pressure relief valves in the water and gas processing systems limit the canister pressure to acceptable levels.

Observation: Pressure relief valves were required and utilized during water and gas processing system operations at the Callaway site. A review of Holtec's procedure for MPC sealing at Callaway showed two pressure relief valves in the schematic diagram present in Attachment 8.10. NRC inspectors verified the presence of these pressure relief values during the second dry-run, June 2-4, 2015, and during initial fuel loading operations at Callaway. The safety relief valves were set at two different pressure values, 95 and 140 psig. The design pressure of the MPC was 100 psig. The 95 psig pressure relief valve was utilized throughout the canister drying and backfilling process. The 140 psig pressure relief valve was utilized during the hydrostatic testing of the MPC when the pressure of the system was raised to 125 psig.

Documents Reviewed: a) Holtec Procedure HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: Loading Operations **Topic:** Time-to-Boil Time Limits

Reference: FSAR 1032, Section 4.5.3 and Table 4.5.4 Revision 3

Requirement Wet transfer operations begin when the lid is placed on the canister in the spent fuel pool and end when the canister is blown down following pressure testing. During wet operations, the water inside the MPC is not permitted to boil. Using the design basis heat load, Table 4.5.4 of the FSAR provides the time-to-boil for various initial water temperatures. If wet transfer operations cannot be completed prior to boiling, a forced water circulation shall be initiated and maintained to remove decay heat from the canister cavity. The minimum water flow rate required to maintain the MPC cavity water temperature below boiling with an adequate subcooling margin is determined using a calculation provided in Section 4.5.3 of the FSAR.

Observation: Callaway had procedure steps in place that adequately calculated and controlled the time to boil limitations put into place by the Holtec FSAR. Holtec's MPC loading procedure for Callaway included a time to boil calculation that was based on the HI-STORM FW FSAR. The HI-STORM FW used the same MPC design as the Holtec UMAX at Callaway. The calculation for the time to boil appeared in Step 7.6.40 of the loading procedure, HPP-2253-200. In addition, the MPC sealing procedure included steps that precluded draining the HI-TRAC/MPC annulus until the MPC blow down was to begin. Adherence to the time to boil clock, assures that the fuel assemblies and cladding would be maintained at acceptable temperatures until just prior to the start of force helium dehydration, which also controlled cladding temperatures until the helium backfill has been completed.

If the time to boil limit could not be met, Callaway's procedure HPP-2253-300 Attachment 8.13, "Contingency Steps for MPC Alternate Cooling," required establishing a forced water circulation with minimum flow rate of 11 gallons per minute that was calculated in accordance with FSAR Section 4.5.3.

Documents Reviewed: a) Holtec Procedure HPP-2253-200, "MPC Loading at Callaway," Revision 9; b) Holtec Procedure HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: Loading Operations **Topic:** Transfer Cask Inspections Prior to Use

Reference: FSAR 1040, Table 10.4.1 Revision 2

Requirement The following HI-TRACK VM transfer cask area shall be inspected prior to use: a) HI-TRAC cavity visual inspection; b) HI-TRAC TAL visual inspection; c) HI-TRAC bottom lid bolts and bolt holes; d) HI-TRAC water jacket visual verification.

Observation: The licensee had incorporated the UMAX FSAR requirements into Procedure ETP-ZZ-04021 and Preventive Maintenance (PM) job order PM 1008270. The documents performed the required HI-TRAC VW cavity visual inspection, HI-TRAC Threaded Anchor Location (TAL) visual inspection, HI-TRAC bottom lid bolts & bolt holes inspection, and HI-TRAC waterjacket visual verification prior to HI-TRAC VW use.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04021, "ISFSI Loading Campaign Performance - IPTE," Revision 1; b) Callaway Procedure PM1008270, "Perform HI-Trac Inspection per HI-STORM FW FSAR Table 9.2.5 and UMAX FSAR Section 10.4.1," Revision 0

Category: NDE-Helium Leak Testing **Topic:** Helium Leak Test-Vent/Drain Covers

Reference: CoC 1040, Tech Spec A.3.1.1.3 Amendment 0

Requirement The helium leak rate through the canister vent and drain port confinement welds shall meet the leak tight criteria of ANSI N14.5 (1997). This degree of containment is achieved by demonstration of a leakage rate less than or equal to 2 X 10(-7) atm·cc/sec of helium at an upstream pressure of 1 atmosphere (atm) absolute (abs) and a downstream pressure of 0.01 atm abs or less.

Observation: The helium leak test was demonstrated during the welding dry run May 19-21, 2015 consistent with the acceptance standards specified in Certificate of Compliance 1040 and ANSI N14.5-1997. Procedure MSLT-MPC-Holtec, Step 8.1 required that the total leak rate of the vent port plus the drain port be less than or equal to 2 x 10(-7) atm cc/sec helium. Additionally, NRC inspectors witnessed the helium leak rate test on the first canister loaded on September 1, 2015. The leak rate was verified to be below the Technical Specification limit.

Documents Reviewed: a) MSLT-MPC-Holtec, "Helium Mass Spectrometer Leak Test Procedure MPC," Revision Callaway-01

Category: NDE-Helium Leak Testing **Topic:** HMSLD Minimum Sensitivity

Reference: ANSI N14.5, Section 8.4 Published 1997

Requirement The helium mass spectrometer leak detector (HMSLD) shall have a minimum sensitivity of 1/2 the acceptance leak rate. For example, a package with a leak tight acceptance criteria of 1.0 X 10(-7) ref-cc/sec requires a minimum helium mass spectrometer leak detector sensitivity of 5.0 x 10(-8) ref-cc/sec. This sensitivity requirement applies to both the hood and detector probe methods. The helium mass spectrometer leak detector shall be calibrated to a traceable standard.

Observation: The helium mass spectrometer leak detector (MSLD) minimum sensitivity requirement was specified in Callaway's procedure. Procedure MSLT-MPC-Holtec, Step 4.1 required the MSLD sensitivity to be less than 1/2 the acceptance criteria leak rate. The minimum acceptable leak rate was stated in Section 8.2 as 2.0 x 10(-7) atm-cc/sec (He) and referenced Technical Specification 3.1.1.3. Technical Specification 3.1.1.3 required the helium leak rate through the canister vent and drain port confinement welds to meet the leak tight criteria specified in ANSI N14.5-1997. Section 2, "Definitions," of ANSI N14.5-1997 defined leak tight as having a leak rate of 1 x 10(-7) ref-cc/sec of air. A note to the definition stated that 1 x 10(-7) ref-cc/sec of air was equivalent to 2 x 10(-7) atm-cc/sec of helium. A calibration standard traceable to the National Institute of Standards and Technology (NIST) with a leak rate between 10(-6) and 10(-8) atm-cc/sec was required by Step 4.3 of Procedure MSLT-MPC-Holtec. Section 5.0, "MSLD Startup and Instrument Calibration," provided instructions on calibrating the helium mass spectrometer. On September 1, 2015, NRC inspectors observed the qualified non-destructive examiner properly set up the MSLD per Callaway's approved procedure and perform the helium leak test.

Documents Reviewed: a) MSLT-MPC-Holtec, "Helium Mass Spectrometer Leak Test Procedure MPC," Revision Callaway-01

Category: NDE-Liquid Penetrant **Topic:** Acceptance Criteria

Reference: ASME Section III, Article NB-5352 Published 2007

Requirement Only indications with major dimensions greater than 1/16 inch should be considered relevant. The following relevant indications are unacceptable: (1) any cracks or linear indications. Linear indications have a length at least 3 times greater than the width; (2) rounded indications with dimensions greater than 3/16 inch (5 mm); (3) more than four rounded indications in a line, separated by 1/16 inch (1.5 mm) or less edge to edge; and (4) ten or more rounded indications in any 6 square inch area in the most unfavorable location relative to the indications being evaluated.

Observation: The acceptance standards from ASME Section III are found in Appendix A, "Acceptance Standards," of the PCI liquid dye penetrant procedure, GQP-9.2. These criteria were fully met during the welding dry-run at Callaway on May 19-21, 2015 and during the first fuel loading at Callaway, which began on August 24, 2015.

Documents Reviewed: a) PCI General Quality Procedure, GQP-9.2, "High Temperature Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 8; b) PCI General Quality Procedure, GQP-9.7, "Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 11

Category: NDE-Liquid Penetrant **Topic:** Contaminants

Reference: ASME Section V, Article 6, T-641 Published 2007

Requirement The user shall obtain certification of contaminant content for all liquid penetrant materials used on austenitic stainless steels. The certifications shall include the manufacturers batch number and sample results. Sub-article T-642 limits the total halogen (chlorine plus fluorine) content of each agent (penetrant, cleaner and developer) to 1.0 weight percent (wt.%) when used on austenitic stainless steels.

Observation: NRC inspectors reviewed vendor supplied laboratory test results for the liquid dye penetrant, developer, and cleaner used for non-destructive testing at Callaway and verified that the total halogen content of each agent did not exceed the ASME Section V, Article 6, T-641 requirement of 1% (by weight) for use on austenitic stainless steels.

Documents Reviewed: a) Sherwin Incorporated Certification for DUBL-CHEK KO-19, Batch No. 06-B56; b) Sherwin Incorporated Certification for DUBL-CHEK KO-17, Batch No. 07-B54; c) Sherwin Incorporated Certification for DUBL-CHEK D-350, Batch No. 99-L71

Category: NDE-Liquid Penetrant **Topic:** Final Interpretation

Reference: ASME Section V, Article 6, T-676.1 Published 2007

Requirement Final interpretation shall be made after allowing the penetrant to bleed-out for 10-60 minutes under standard temperatures (50 and 125 degrees F). The 10-60 minute clock starts immediately after application of a dry developer.

Observation: PCI's liquid dye penetrant procedure, GQP-9.7, had the requirements of ASME Section V, Article 6, T-676.1 spelled out in step 9.7.1(a). For high temperature uses, procedure GQP-9.2 will be used. GQP-9.2 was used during welding dry-run activities at the Callaway site. The manufacturer's instructions (Sherwin Incorporated) for the high temp penetrant, KO-17, high temperature cleaner, KO-19, and high temperature developer, D-350, listed different developer dwell times based on the surface temperature of the area being examined. The use of the Sherwin high temperature liquid penetrant products was fully qualified by PCI for use during dry fuel storage operations at Callaway. The manufacturer's recommendations supersede general code requirements in situations such as this one.

Documents Reviewed: a) PCI General Quality Procedure GQP-9.7, "Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 11; b) PCI GQP-9.2, "High Temperature Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 8

Category: NDE-Liquid Penetrant **Topic:** Lid-To-Shell Weld PT

Reference: CoC 1040, Appendix B, Table 3-1 Amendment 0

Requirement Only ultrasonic testing or multi-layer liquid penetrant (PT) examination is permitted on the lid-to-shell weld. If PT alone is used, at a minimum, it will include the root and final weld layers and each approximately 3/8 inch of weld depth.

Observation: PCI's Project Instruction called out the requirement that liquid penetrant (PT) examination shall be performed after the root layer and every layer of weld material afterwards. The layer was defined as equal to or less than 3/8 inch thickness (consisting of one or more passes), as referenced in the Holtec CoC 1040, Appendix B, Table 3-1. This requirement was met in the procedure and observed in practice during the welding dry-run activities at Callaway the week of May 18, 2015.

Documents Reviewed: a) PCI Project Instruction PI-CNSTR-OP-H-01, "Closure Welding of Holtec Multi-Purpose Canisters - UMAX," Revision 0

Category: NDE-Liquid Penetrant **Topic:** Minimum Elements

Reference: ASME Section V, Article 6, T-621 Published 2007

Requirement Each liquid penetrant (PT) procedure shall include the requirements listed in Table T-621: (1) type of each penetrant, remover, emulsifier, and developer; (2) Surface preparation (finishing and cleaning, including type of cleaning solvent); (3) Method of applying penetrants; (4) Method of removing excess surface penetrant; (5) Hydrophilic or lipophilic emulsifier concentration and dwell time in dip tanks and agitation time for hydrophilic emulsifiers; (6) Hydrophilic emulsifier concentration in spray applications; (7) Method of applying developer; (8) Minimum and maximum time periods between steps and drying aids; (9) Decrease in penetrant dwell time; (10) Increase in developer dwell time (Interpretation Time); (11) Minimum light intensity; (12) Surface temperature outside 40 degrees F to 125 degrees F or as previously qualified; (13) Performance demonstration, when required; (14) Personnel qualification requirements; (15) Materials, shapes, or sizes to be examined and the extent of examination; and (16) Post-examination cleaning technique.

Observation: The two procedures in use by PCI both contain all of the applicable minimum elements as specified in ASME Section V with the following allowed exceptions: Elements 5 and 6, both dealing with hydrophilic or lipophilic emulsifier concentration, did not apply to the specific types of dye penetrants and developers used for NDE at Callaway. Also, the temperature range of element #12 was not met, 40 to 125 degrees F. Instead, the solvent, dye, and developer used at Callaway by PCI were qualified for use from 50 to 350 degrees F. PCI and Callaway met the code required minimum elements in their liquid dye penetrant procedures.

Documents Reviewed: a) PCI General Quality Procedure GQP-9.2, "High Temperature Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 8; b) PCI General Quality Procedure GQP-9.7, "Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 11

Category: NDE-Liquid Penetrant **Topic:** Removing Excess Penetrant

Reference: ASME Section V, Article 6, T-673.3 Published 2007

Requirement Excess solvent removable penetrants shall be removed by wiping with a cloth or absorbent paper until most traces of the penetrant have been removed. The remaining traces shall be removed by lightly wiping the surface with a cloth or absorbent paper moistened with solvent. Care shall be taken to avoid the use of excess solvent. Flushing the surface with solvent, following the application of the penetrant and prior to developing, is prohibited.

Observation: The PCI Liquid Dye Penetrant procedure was compliant with the requirements of ASME Section V, Article 6, T-673.3, but included provisions for spraying the cleaner solvent directly onto the surface of the area to be inspected. Consultation with the manufacturer's recommendations for Dubl-Chek KO-19 cleaner indicated that this was an acceptable practice. Further consultation with HQ and an industry Level III NDE technician indicated that since KO-19 was applied as a foam, spraying it directly onto the surface to be examined does not constitute "flushing the surface" with solvent. PCI was fully compliant with the ASME requirements and manufacturers recommendations for use and removal of excess dye penetrant.

Documents Reviewed: a) PCI General Quality Procedure, GQP-9.2, "High Temperature Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 8; b) Sherwin Incorporated KO-19 Hi-Temp Remover Technical Data Sheet

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Category: NDE-Liquid Penetrant **Topic:** Surface Preparation

Reference: ASME Section V, Article 6, T-642 (b) Published 2007

Requirement Prior to each liquid penetrant examination, the surface to be examined and all adjacent areas within one inch must be dry and free of all dirt, grease, lint, scale, welding flux, weld spatter, paint, oil, and other extraneous matter that could obscure surface openings or otherwise interfere with the examination.

Observation: PCI's liquid penetrant procedure included the requirement that the surface to be examined be free of all dirt, grease, link, scale, welding flux, weld spatter, and other contaminants on the surface in step 9.1.1.b. PCI's procedure was fully compliant with the requirements listed in ASME Section V, Article 6, T-642(b).

Documents Reviewed: a) PCI General Quality Procedure, GQP-9.2, "High Temperature Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 8

Category: NDE-Personnel Qualification **Topic:** Certification Records

Reference: SNT-TC-1A, Section 9 Published 1992

Requirement Certification records should contain the name of the certified individual, the certification level and method, the individual's educational background and NDE experience, a statement of satisfactory completion of training per the employer's written practice, visual examination results, evidence of successful completion of examinations including grades, date of certification, and the signature of the employer.

Observation: NRC inspectors reviewed the training, testing, and certification records for two Level II NDE technicians from PCI. One of the technicians was involved in the dry-run activities witnessed during the week of May 18, 2015. The other individual was the one who actually participated at Callaway during their initial dry fuel storage campaign. The records for both individuals were complete and included all of the required information as specified by SNT-TC-1A, Section 9.

Documents Reviewed: a) PCI Visual Examination Report; b) PCI NDE VT Level II Personnel Certificate; c) PCI NDE PT Level II Personnel Certificate; and d) PCI Certification of Inspection, Examination, and Testing Personnel

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Category: NDE-Personnel Qualification **Topic:** Level II Exam Grading

Reference: SNT-TC-1A, Section 8 Published 1992

Requirement Level II technicians take 3 examinations: Basic, Method, and Specific. A composite grade should be determined by simple averaging of the results of the 3 examinations. A passing composite grade should be 80% with no examination results below 70%.

Observation: NRC inspectors reviewed the PCI procedure that directs the training, qualification, examination, and certification of NDE personnel. The requirements within the procedure contained the requirements of SNT-TC-1A, Section 8. NRC inspectors verified that the Level II technician had passed all of his composite and individual examination requirements with an acceptable level of accuracy and proficiency. This requirement was met.

Documents Reviewed: a) PCI GQP-9.0 "Training, Qualification, Examination, and Certification of NDE Personnel in Accordance with SNT-TC-1A and CP-189," Revision 15; b) various NDE VT Level II Personnel Certificates, NDE PT Level II Personnel Certificates, and a Certificate of Inspection, Examination, and Testing Personnel for the individual who performed VT and PT for the welding dry-run at Callaway

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Category: NDE-Personnel Qualification **Topic:** Level III Candidates

Reference: SNT-TC-1A, Section 6 Published 1992

Requirement A Level III candidate who has completed less than 2 years of engineering or science study must have 4 years of experience comparable to a Level II. A Level III candidate who has completed 2 years of engineering or science study must have 2 years of experience comparable to a Level II. A Level III candidate who has completed 4 years of engineering or science study must have 1 year of experience comparable to a Level II.

Observation: The welding contractor for Callaway, PCI, had these requirements clearly spelled out in its procedure for training and qualification of NDE personnel. Step 7.5.2 of the procedure laid out the education, training, and relevant experience requirements for Level III technicians. PCI had implemented Level III requirements that were fully compliant with SNT-TC-1A, Section 6.

Documents Reviewed: a) PCI Procedure GQP-9.0, "Training, Qualification, Examination, and Certification of NDE Personnel in Accordance with SNT-TC-1A and CP-189," Revision 15

Category: NDE-Personnel Qualification **Topic:** Recertification of Personnel

Reference: SNT-TC-1A, Section 9 Published 1992

Requirement Maximum recertification intervals are 3 years for Levels I and II, and 5 years for Level III. Recertification may be granted without testing provided there is documented continuing satisfactory performance. Without documented continuing satisfactory performance, reexamination is required for those sections deemed necessary by the Level III examiner.

Observation: PCI's procedure, GQP-9.0, for training and qualification of NDE personnel covered recertification requirements in Steps 11.2.1 through 11.2.7. The requirements of SNT-TC-1A, Section 9 were met by PCI's written procedure. PCI's procedure does not address Level I personnel. However, no Level I personnel were supporting dry fuel storage activities at Callaway.

Documents Reviewed: a) PCI Procedure, GQP-9.0, "Training, Qualification, Examination, and Certification of NDE Personnel in Accordance with SNT-TC-1A and CP-189," Rev. 15

Category: NDE-Personnel Qualification **Topic:** Visual Acuity

Reference: SNT-TC-1A, Section 8.2 Published 1992

Requirement The NDE examiner should have natural or corrected near-distance acuity in at least one eye capable of reading Jaeger Number 1 at a distance of not less than 12 inches on a standard Jaeger test chart, or capable of perceiving a minimum of 8 on an Ortho-Rater test pattern. This should be verified annually. The NDE examiner should demonstrate the capability of distinguishing and differentiating contrast among colors used in the applicable method. This should be verified every 3 years.

Observation: PCI Procedure GQP-9.0 required visual acuity examinations for NDE personnel in accordance with SNT-TC-1A. The overarching procedure, GQP-9.0 established the yearly frequency for the visual examination of the NDE personnel. GQP-9.14 established a procedure for carrying out the visual examination which included near and far distance visual acuity and color discrimination. PCI had adequate instructions and procedures in place to support qualification of personnel to perform NDE examinations. NRC also inspected the visual evaluation reports for PCI staff NDE personnel. Dry fuel operations at Callaway met this requirement.

Documents Reviewed: a) PCI General Quality Procedures GQP-9.14, "Visual Acuity Examinations," Revision 2; b) PCI GQP-9.0, "Training, Qualification, Examination, and Certification of NDE Personnel in Accordance with SNT-TC-1A and CP-189," Revision 15; c) PCI Visual Evaluation Report, SAP# 73566

Category: NDE-Personnel Qualification **Topic:** Written Practice

Reference: SNT-TC-1A, Section 5 Published 1992

Requirement The employer shall establish a written practice for control and administration of non-destructive testing personnel training, examination, and certification. The written practice should describe the responsibility of each level of certification for determining the acceptability of material or components. The written practice shall describe the training experience and examination requirements for each level of certification.

Observation: PCI Procedure GQP-9.0 established the written requirements for NDE personnel qualifications and included sections that address personnel certification levels, responsibilities, education, experience requirements, training, visual acuity examinations, and certification examinations. PCI handing of personnel qualifications was fully compliant with SNT-TC-1A, Section 6.

Documents Reviewed: a) PCI Procedure GQP-9.0, "Training, Qualification, Examination, and Certification of NDE Personnel in Accordance with SNT-TC-1A and CP-189," Revision 15

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Arc Strikes

Reference: ASME Section III, Article NF-5360 (i) Published 2007

Requirement Arc strikes and blemishes in the weld or base material are acceptable, provided no cracking is visually detected.

Observation: The arc strike acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME

Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6 "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Cracks

Reference: ASME Section III, Article NF-5360 (a) Published 2007

Requirement Cracks are unacceptable.

Observation: The crack acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Craters

Reference: ASME Section III, Article NF-5360 (e) Published 2007

Requirement Craters outside the weld area are irrelevant, provided there are no cracks.

Observation: The craters acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6, Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Fusion

Reference: ASME Section III, Article NF-5360 (c) Published 2007

Requirement For fillet welds, incomplete fusion of more than 3/8" (10 mm) in any 4" (100 mm) segment is unacceptable. For fillet welds, incomplete fusion of more than 1/4" (6 mm) in welds less than 4" (100 mm) is unacceptable. For groove welds, any incomplete fusion is unacceptable. Rounded end conditions (starts and stops) shall not be considered indications of incomplete fusion.

Observation: The fusion acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Lengths

Reference: ASME Section III, Article NF-5360 (h) Published 2007

Requirement For welds 3" and longer, weld lengths shorter than specified by more than 1/4" (6 mm) are unacceptable. For welds less than 3" long, weld lengths shorter than specified by more than 1/8" (3.2 mm) are unacceptable. Intermittent welds not spaced within 1" (25 mm) of the specified location are unacceptable.

Observation: The weld length acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Overlap

Reference: ASME Section III, Article NF-5360 (d) Published 2007

Requirement When fusion in the overlap length cannot be verified, an overlap length of greater than 3/8" (10 mm) in any 4" (100 mm) segment, and 1/4" (6 mm) in welds less than 4" (100 mm) long, is unacceptable.

Observation: The overlap acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Porosity

Reference: ASME Section III, Article NF-5360 (g) Published 2007

Requirement The following degrees of random porosity are unacceptable: (1) the sum of the diameters of random porosity exceeding 3/8" (10 mm) in any one linear inch of weld; (2) the sum of the diameters of random porosity exceeding 3/4" (19 mm) in any 12 linear inches (305 mm) of weld; or (3) four or more pores aligned, and the pores separated by 1/16" (1.6 mm) or less edge to edge.

Observation: The porosity acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Slag

Reference: ASME Section III, Article NF-5360 (j) Published 2007

Requirement Slag 1/8" (3.2 mm) or less in size is irrelevant. Slag greater than 1/4" (6 mm) in size after cleaning is unacceptable.

Observation: The slag acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Thickness

Reference: ASME Section III, Article NF-5360 (b) Published 2007

Requirement Welds thinner than specified by greater than 1/16" (1.6 mm) for more than one-fourth the weld length are unacceptable. Welds thicker than specified are unacceptable if they interfere with mating parts.

Observation: The weld thickness acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Acceptance Criteria - Undercut

Reference: ASME Section III, Article NF-5360(f)(2) Published 2007

Requirement Undercuts deeper than 1/32" (.8 mm) on one side for the full length of the weld are unacceptable. Undercuts deeper than 1/32" (.8 mm) on one side for one-half the length of the weld AND deeper than 1/16" (1.6 mm) on the same side for one-fourth the length of the weld, are unacceptable.

Observation: The undercut acceptance criteria was incorporated into the visual weld examination procedure. Procedure GQP-9.6 Addendum 1 included the requirements of the ASME Section III, Article NF-5360, which was utilized by the NDE inspector during visual examinations to verify the acceptance criteria was met.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Eye Position and Lighting

Reference: ASME Section V, Article 9, T-952 Published 2007

Requirement Direct visual examinations shall be conducted with the eye within 24" (610 mm) of the surface, at an angle not less than 30 degrees. The minimum light level shall be 100 foot-candles.

Observation: The PCI procedure used at Callaway, Procedure GQP-9.6, was verified by NRC inspectors to contained the ASME Section V, Article 9, T-952 requirement. PCI Procedure GQP-9.6, Step 4.1 stated "Direct visual examinations are those which can be made when access is sufficient to place the eye within 24 inches of the surface and at an angle not less than 30 degrees to the surface to be examined. Mirrors may be used to improve the angle of vision, and aids such as a magnifying lens may be used to assist examinations." Step 6.2 of the procedure stated "For direct visual examination, lighting shall be provided such that the specific part, component, vessel or section thereof, under immediate examination is illuminated to attain a minimum of 100 foot-candles. Illumination may be by any means including a hand held flashlight."

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Minimum Elements

Reference: ASME Section V, Article 9, T-921.1 Published 2007

Requirement Each Visual Testing (VT) procedure shall include the: (1) Technique used either direct or remote; (2) Remote visual aids; (3) Personnel performance requirements, when required; (4) Lighting intensity; (5) Configurations to be examined and base material product forms(pipe, plate, forgings, etc.); (6) Lighting equipment; (7) Methods or tools used for surface preparation; (8) Equipment or devices used for a direct technique; (9) sequence of examination; (10) Personnel qualifications.

Observation: The PCI procedure used at Callaway, GQP-9.6, was verified by NRC inspectors to contained the required elements specified by ASME Section V, Article 9, T-921.1 related to visual examination (testing) requirements.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14

Category: NDE-Visual Examination **Topic:** Procedure Validation

Reference: ASME Section V, Article 9, T-921.3 Published 2007

Requirement The procedure shall contain or reference a report of what was used to demonstrate that the examination procedure was adequate. In general, a fine line 1/32" or less in width, or some other artificial flaw located on the surface or a similar surface to that to be examined, may be considered a test method for this demonstration. The line or artificial flaw should be in the least discernible location on the area examined, to prove the procedure.

Observation: NRC inspectors reviewed procedure qualification record for the PCI Procedure GQP-9.6 used at Callaway, that demonstrated the visual examination procedure was adequate. PCI Letter "Visual Examination Demonstration to HSB Global Standards ANI of GQP 9.6 Revision 14," dated December 4, 2013, documented the qualification of PCI's procedure. Attached to the letter was the visual testing examination report form that documented the qualification results.

Documents Reviewed: a) PCI Procedure GQP-9.6, "Visual Examination of Welds," Revision 14; b) PCI Letter, "Visual Examination Demonstration to HSB Global Standards ANI of GQP 9.6 Revision 14," dated December 4, 2013

Category: Pressure Testing **Topic:** Governing Code

Reference: FSAR 1032, Section 10.1.2.2.2 Revision 3

Requirement Pressure testing (hydrostatic or pneumatic) of the canister confinement boundary shall be performed in accordance with the requirements of ASME Code Section III, Subsection NB, Article NB-6000, when field welding of the canister lid-to-shell weld is completed. If hydrostatic testing is used, the canister shall be pressure tested to 125% of design pressure.

Observation: The requirements for the canister hydrostatic testing had been incorporated into Procedure HPP-2253-300 consistent with ASME Code Section III, Subsection NB, Article NB-6000. The canister design pressure was 100 pounds per square inch-gauge (psig) per Holtec UMAX FSAR, Table 2.3.5 "Design (Maximum Allowable) Pressures." Procedure HPP-2253-300, Section 8.4, "Hydrostatic Test with FHD" provided the instructions for performing the canister hydrostatic test. Procedure HPP-2253-300, Step 7.4.30 required pressurizing the canister to 125.5-129.5 psig. Test results were documented in Step 7.4.41 after the pressure was maintained for 10 minutes. Procedure Step 7.4.42 required an Ameren Representative to witness the hydrostatic test and sign off on the test results.

Documents Reviewed: a) Holtec Procedure, HPP-2253-300 "MPC Sealing at Callaway," Revision 7

Category: Pressure Testing **Topic:** Hydrostatic Testing Sequence

Reference: FSAR 1032, Table 2.2.1, Sections 9.2.5;10.1.2.2.2 Revision 3

Requirement During hydrostatic testing, demineralized water or spent fuel pool water is admitted to the canister through a supply line connected to the drain port RVOA. The canister is pressurized to 125 +5/-0 psig and held for 10 minutes with no pressure drop. Following the 10-minute hold at test pressure, the canister lid to shell weld is examined to confirm no observable water leakage. The canister is then depressurized through a return line connected to the vent port RVOA and routed back to the spent fuel pool or liquid radwaste system. Once the canister is depressurized, the liquid penetrant examination of the canister lid-to-shell weld is repeated. Any evidence of cracking or deformation is cause for rejection.

Observation: NRC inspectors verified that the hydrostatic testing was performed properly with a positive displacement pump. The technician maintained the pressure in the correct pressure range (125.5 – 129.5 psi) for the ten minutes prescribed by the testing procedure. NRC observed the hydrostatic test during dry-run #2 June 2-4, 2015.

Documents Reviewed: a) Holtec Procedures HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: Pressure Testing **Topic:** Pressure Gauge Calibration

Reference: ASME Section III, Article NB-6413 Published 2007

Requirement All test gauges shall be calibrated against a standard dead weight tester or a calibrated master gauge. The gauges shall be calibrated before each test or series of tests. A series of tests is that group of tests using the same pressure test gauge or gauges, which is conducted at the same site within a period not exceeding 2 weeks.

Observation: The test gages used to verify compliance for the hydrostatic test of the canister lid weld were required to be calibrated within 2 weeks of use. This requirement was stated in prerequisite Step 5.10 which required the pressure gauges for vent and drain ports to be calibrated within 2 weeks of the next test.

Documents Reviewed: a) Holtec Procedure, HPP-2253-300 "MPC Sealing at Callaway," Revision 7

Category: <u>Pressure Testing</u> **Topic:** <u>Pressure Gauge Installation</u>

Reference: ASME Section III, Article NB-6411 Published 2007

Requirement Pressure test gauges shall be connected directly to the component and visible to the operator controlling test pressure.

Observation: Pressure testing of the lid to shell weld at Callaway complied with the ASME requirements. Holtec Procedure HPP-2253-300 Attachment 8.10 "Hydrostatic Test System and Blowdown Setup," required the pressure gages to be directly connected to the Remote Valve Operating Assembly (RVOA), which connects to the vent and drain ports of the MPC. The hydrostatic pump was located next to the MPC in the Cask Washdown Pit making the test gages visible to the operator controlling the test pressure.

Documents Reviewed: a) Holtec Procedure HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: <u>Pressure Testing</u> **Topic:** <u>Pressure Gauge Ranges</u>

Reference: ASME Section III, Article NB-6412 Published 2007

Requirement Analog type indicating pressure gauges used in testing shall be graduated over a range not less than 1.5 times nor more than 4 times the test pressure. Digital type pressure gauges may be used without range restriction.

Observation: Only digital pressure gauges were in use at Callaway during the preoperational dry-runs and the initial loading campaign for the Holtec UMAX ISFSI. Therefore, the gauges used at Callaway did not have use restrictions.

Documents Reviewed: a) Holtec Procedures HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: <u>Pressure Testing</u> **Topic:** <u>Thermal Expansion</u>

Reference: ASME Section III, Article NB-6126 Published 2007

Requirement If a pressure test is to be maintained for a period of time and the test medium in the system is subject to thermal expansion, precautions shall be taken to avoid excessive pressure.

Observation: Precautions were taken to guard against over-pressurization of the canister during MPC sealing operations at Callaway. The Holtec procedure used at Callaway directed the technician to actively monitor pressure at all times during the hydro-static testing of the MPC lid to shell weld. Procedure steps 7.4.28 through 7.4.42 direct the technician to actively throttle the pressure while maintaining it within a certain acceptable band (125.5 – 129.5 psi) during the pressure test. NRC inspectors interviewed the Holtec cask loading supervisor and loading technician on the technique that would be followed. They both responded that the technician would be holding a throttle valve for the entire pressure test and maintaining the pressure manually. At any point during the test, the technician can release the pressure. The diligence of the technician would thereby limit the pressure to acceptable levels. There was also one relief valves in the line-up during the hydrostatic test, rated at 140 psi.

Documents Reviewed: a) Holtec Procedures HPP-2253-300, "MPC Sealing at Callaway," Revision 7

Category: Quality Assurance **Topic:** Approved QA Program

Reference: 10 CFR 72.140(d) Published 2015

Requirement A QA program previously approved by the Commission as satisfying the requirements of Appendix B to Part 50 will be accepted as satisfying the requirements of Part 72. In filing the description of the QA program required by Part 72.140(c), each licensee shall notify the NRC of it's intent to apply it's previously approved QA program to ISFSI activities. The notification shall identify the previously approved QA program by date of submittal, docket number and date of Commission approval.

Observation: The licensee had incorporated the Part 72 quality assurance requirements into their approved Part 50 quality assurance plan. Callaway sent a letter to the NRC on February 13, 2015, notifying the Commission of their intent to apply the previously approved 10 CFR Part 50 Quality Assurance Program to cover ISFSI activities at their site. Callaway's Operational Quality Assurance Manual (OQAM) Revision 31, was reviewed by inspectors during the programs review week and was found to adequately incorporate the Part 72 ISFSI activities.

Documents Reviewed: a) Callaway's Operational Quality Assurance Manual, Revision 31; b) Letter to NRC "Notification Pursuant to 10 CFR 72.140 (d) of Intent to Apply Previously Approved Quality Assurance Program to the ISFSI at Callaway Plant, Unit 1," dated 02/13/2015

Category: Quality Assurance **Topic:** Corrective Actions

Reference: 10 CFR 72.172 Published 2015

Requirement The licensee shall establish measures to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures must ensure that the cause of the condition is determined and corrective action taken to preclude repetition. This must be documented and reported to appropriate levels of management.

Observation: The licensee had incorporated the tracking and addressing conditions adverse to quality of ISFSI activities into their Part 50 approved Corrective Action Program. Callaway Procedure APA-ZZ-00500 described the corrective action process and provided instructions for initiating a Corrective Action Request System (CARS). Plant management was involved in the process of reviewing CARs and periodic reports on the status of open or closed CARs.

Condition reports that had been issued related to the ISFSI activities and the fuel building crane were reviewed during the dry run and first loading inspections to evaluate whether conditions adverse to quality were being appropriately identified and adequately corrected. A large number of CARs written dealing with ISFSI construction, dry runs, programs review, and issues discovered during the first loading were reviewed by the NRC inspectors. The CARs were related to a variety of issues. The CARs reviewed were well documented and properly categorized based on the safety significance of the issue. The corrective actions taken were appropriate for the situations. Based on the comprehensiveness of the corrective action reports, the licensee demonstrated a high attention to detail in regard to the setup, maintenance, and operation of their ISFSI program and the cask handling crane. No NRC safety concerns were identified related to the condition reports reviewed.

Documents Reviewed: a) Callaway Procedure APA-ZZ-00500, "Corrective Action Program," Revision 61; b) CARS # 201505151,2015505142, 201504137, 201503680, 201502667, 201502190, 201501660, 201501252, 201501155, 201501154, 201501047, 201406571, 201405949, and 201405323

Category: Quality Assurance **Topic:** Important to Safety Components - Ancillaries

Reference: FSAR 1032, Table 9.2.1 Revision 3

Requirement Ancillary equipment shall be classified as important to safety (ITS) in accordance with FSAR Table 9.2.1.

Observation: All Important to Safety (ITS) classifications contained in Table 9.2.1 of the HI-STORM FW FSAR (referenced by the UMAX FSAR) were consistent with the licensee's safety classifications in Holtec Document ID: 2253-C2015-46R2 for ancillary equipment except for the MPC Lifting Slings. Table 9.2.1 classified the lifting slings as ITS Category A while the licensee classified the slings as ITS Category B. An evaluation was performed by Holtec for the lifting slings in Purchase Specification (PS) PS-1234 that provided the justification for the slings as ITS Category B due to an evaluation that demonstrated that a 25 foot MPC drop will not breech the MPC containment boundary. Therefore, failure of a lifting sling would not directly cause loss of containment integrity and classification of the lifting slings as ITS Category B was justified. In addition, the inspectors noted in the FSAR Table 9.2.1 under the MPC Lift Attachments section, it stated, in part, that the ITS classification of the lifting device attached to the attachments may be lower than the attachment itself, as determined site-specifically. The MPC Lift Attachments are classified as ITS Category A equipment.

Documents Reviewed: a) Holtec Document 2253-C2015-46R2, "Safety Classification Summary of All Equipment to be Delivered Under Specification M-2020," Revision 1; b) Holtec Procedure PS-1234, "Purchase Specification for the MPC Downloading Sling for Downloading Using the VCT," Revision 4

Category: Quality Assurance **Topic:** Important to Safety Components - Cask System

Reference: FSAR 1032, Table 2.0.2, 2.0.3, 2.0.4, and 2.0.7 Revision 3

Requirement Structures, systems, and components of the HI-STORM UMAX cask system are identified as important to safety (ITS) in accordance with NUREG/CR-6407 "Classification of Transportation and Dry Spent Fuel Storage System Components." Holtec FW FSAR, Tables 2.0.2, 2.0.3, 2.0.4, and 2.0.7 provides a summary of the classification of the structures, systems, and components as important to safety A, B, C, and NTIS (not important to safety).

Observation: Callaway had listed the Important to Safety structures, systems, and components (SSCs) associated with the UMAX/FW systems appropriately in their Quality Assurance Program implementing procedures. Callaway Procedure APA-ZZ-00303 documented that the ITS SSCs associated with the UMAX were defined in Holtec Report HI-2135435. Callaway Procedure APA-ZZ-00303 Appendix 1, documented that the ITS SSCs associated with the MPC, HI-TRAC VW, and other loading equipment was documented in Holtec Letter 2253-C2015-46R2. The Holtec report and letter were reviewed and were determined to be consistent with the tables in the FSAR and NUREG/CR-6407.

Documents Reviewed: a) Callaway Procedure APA-ZZ-00303, "Classification of Systems," Revision 16; b) Callaway Procedure APA-ZZ-00303, Appendix 1 "Callaway Director Olant System Classification Data," Revision 11; c) Holtec Report HI-2135435, "ITS Categorization for the UMAX System," Revision 2; d) Holtec Document ID:2253-C2015-46R2, "Letter from Holtec, Safety Classification Summary of All Equipment to be Delivered Under Specification M-2020," dated July 1, 2015

Category: Quality Assurance **Topic:** Instruments Requiring Calibration

Reference: FSAR 1032, Section 10.4 Revision 3

Requirement Instruments requiring calibration include flow rate monitors, canister pressure gauges, gas and water temperature gauges, temperature surface pyrometer, vacuum gauge for gas sampling and moisture monitoring instruments for Forced Helium Dehydration (FHD) operations.

Observation: Instruments requiring calibration were verified as being properly calibrated before use. NRC inspectors reviewed the calibration of many temperature gages, pressure gages, and flow meters during the dry run activities and the first loading. Callaway Procedure ETP-ZZ-04021 included requirements to verify the calibration of instruments consistent with the instruments listed in the Holtec FW FSAR table.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04021, "ISFSI Loading Campaign Performance - IPT," Revision 1

Category: Quality Assurance **Topic:** QA Audits

Reference: 10 CFR 72.176 Published 2015

Requirement The licensee shall carry out a comprehensive system of planned and periodic audits to verify compliance with all aspects of the QA program and to determine the effectiveness of the program.

Observation: The licensee had developed a comprehensive plan for auditing the spent fuel dry cask storage program which was described in Appendix B of Callaway's Operational Quality Assurance Manual, Revision 31. Callaway's quality assurance organization was conducting audits and surveillances of the dry cask storage activities at Callaway and of the cask vendor, Holtec, which included engineering design activities and the cask manufacturing activities.

Selected QA audits and surveillances were reviewed related to the Callaway's dry cask storage program. The documents reviewed included audits and surveillances of Holtec activities, including work being performed at the Holtec Manufacturing Division, as well as activities being conducted by both Holtec and the licensee's staff at the Callaway site. Audit and surveillance findings were adequately categorized, resolved and documented

Documents Reviewed: a) Callaway's Operational Quality Assurance Manual, Revision 31; b) Callaway Audit Report AP15009, "Dry Cask Storage System, Special Audit, AP15009," dated

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Category: Quality Assurance **Topic:** Receipt Inspection Checklists

Reference: FSAR 1032 Tables 9.2.4, 9.2.5; 1040 Table 10.1.1 Revision 3; 2

Requirement Holtec HI-STORM FW FSAR 1032 Tables 9.2.4 and 9.2.5 provide sample receipt inspection checklists for the canister and HI-TRAC transfer cask. Holtec HI-STORM UMAX FSAR 1040 Tables 10.1.1 a provide sample receipt inspection checklists for the VVM components. Users shall develop site-specific receipt inspection checklists.

Observation: The licensee had incorporated the UMAX FSAR requirements into Procedure ETP-ZZ-04021 and had performed the required receipt inspections for the multipurpose canister, HI-TRAC VW transfer cask, and VVM components. Procedure ETP-ZZ-04021 contained all the receipt inspection attributes listed in FSAR 1032 Table 9.2.4, MPC Inspection Checklist; Table 9.2.5, HI-TRAC VW Transfer Cask Inspection Checklist; and FSAR 1040 Table 10.1.1, HI-STORM UMAX VVM Assembly Inspection and Test Acceptance Criteria.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04021, "ISFSI Loading Campaign Performance - IPTE ," Revision 0

Category: Radiation Protection **Topic:** ALARA Program

Reference: FSAR 1040, Section 11.1.1 Revision 2

Requirement Licensees using the HI-STORM UMAX cask system will utilize and apply their existing site ALARA policies, procedures and practices for ISFSI activities to ensure that personnel exposure requirements of 10 CFR 20 are met.

Observation: The licensee had expanded their existing ALARA program to apply to ISFSI operations. The radiation protection program document (APA-ZZ-01000) described the ALARA Program. Section 4.4, addressed dose to members of the Public. Section 4.5.1, provided Federal Occupational Limits Guidelines. Section 4.5.2, discussed limits for pregnant workers. Section 4.5.4, outlined Administrative Dose Limits and subparagraph (c) noted that minors may not receive an occupational dose. Routine radiological controls were implemented by means of existing Callaway radiological control procedures associated with operation of the 10 CFR 50 facility. The licensee had reviewed and revised existing procedures to ensure compliance with requirements of 10 CFR 20.

The licensee applied lessons learned from other sites and incorporated suggestions from numerous INPO Reports. Man-hour and Person-rem projections were made using data from the Diablo Canyon ISFSI campaign. The licensee committed to use of low dose waiting areas. Two minute drills were observed during dry runs. Radiation Work Permits were developed. Personnel were encouraged to present ideas for reducing exposure during various evolutions. Radiation protection personnel were trained on the limitations of their survey instrumentation. The radiation protection technicians had participated in the Callaway Energy Site dry run demonstrations performed to meet Certificate of Compliance requirements. Radiation Protection personnel were found to be knowledgeable of the various activities and of the associated dose rates that would be expected. Health physics controls to include use of low dose waiting areas were implemented during dry run and loading activities.

Documents Reviewed: a) Callaway Procedure APA-ZZ-01000, "Radiation Protection Program," Revision 41 b) General and Specific Radiation Work Permits as follows by prime number and subtitles - 15001753, "TRNSPRT – Move HI-TRAC From Wash down Pit to HI-STORM UMAX;" "CLOSE – Decontaminate, Close and Prepare MPC for Movement of Canister;" "LOAD – Place MPC into Spent Fuel Pool, Load Assemblies and Prepare for Movement to Cask Wash down Decontamination Pit;" "PREPS – Prepare the HiTrac and MPC for Loading"

Category: Radiation Protection **Topic:** Controlled Area Boundary Dose Rate Analysis

Reference: CoC 1040, Tech Spec A.5.3.2 Amendment 0

Requirement Considering the planned number of casks to be deployed and the cask contents, the licensee shall perform an analysis to confirm the dose limits of 10 CFR 72.104(a) will be satisfied under actual site conditions. 10 CFR 72.104(a) states that the annual dose to any real individual located beyond the controlled area must not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other critical organ as a result of direct radiation from the ISFSI during normal operations and anticipated occurrences. The results of the analysis shall be documented in the 10 CFR 72.212 evaluation report.

Observation: Callaway calculations provided in HPCI 15-05, noted that the annual dose to the nearest resident is 1.09E- 02 mrem, well below the 10 CFR 72.104(a) limit of 25 mrem. Holtec Calculation HI-2135879 in Section 5.3.1.2 compared the dose due to normal operations and anticipated occurrences due to the ISFSI to be compliant with limits of 10 CFR 72.104. Table 5.3-2 of the document noted an annual dose at 1600 meters, the approximate site boundary distance, and 2800 meters, the approximate distance to the nearest residence to be a maximum of less than 2 E-02 mrem, well within the limit of 25 mrem. The calculation assumed a maximum number of stored casks, 48. During loading the licensee measured the Transfer Cask and VVM surface neutron and gamma dose rated for comparison with limits and found results to be satisfactory. Because of the design of the welded and sealed canisters, there were no effluent pathways associated with the stored canisters under normal conditions.

The licensee was required by 10 CFR 72.104 to include doses from other nearby fuel cycle activities into the dose calculations. The operating Callaway Energy Center nuclear power plant as a source term was considered in the determination of whether the dose rate was being met. The license reviewed data for 2012, 2013 and 2014. While the data varied somewhat from year to year, the licensee determined that dose rates at the controlled area boundary were not statistically different from background levels.

Documents Reviewed: a) Callaway Procedure HSP-ZZ-0015, "Callaway Site Boundary Dose Evaluation," Revision 0; b) Callaway Calculation HPCI 15-05, "Evaluation of Direct Radiation Dose to the Member of the Public from the Independent Spent Fuel Storage Installation," Revision 1; c) Holtec Calculation HI-2135879, "ISFSI Site Boundary and CoC Dose Rate Calculations for Callaway Plant Site Boundary," Revision 0

Category: Radiation Protection **Topic:** Controlled Area Radiological Doses

Reference: 10 CFR 72.106(a)/(b)/(c) Published 2015

Requirement For each ISFSI, a controlled area must be established. Any individual located on or beyond the nearest boundary of the controlled area may not receive from any design basis accident 5 rem TEDE for accident conditions. Minimum distance from ISFSI to nearest boundary of controlled area must be 100 meters. Controlled area may include roads, railroads or waterways as long as arrangements are made to control traffic and protect public.

Observation: The ISFSI pad was located within the Callaway Energy Center nuclear power plant exclusion zone within the plant's owner controlled area. Holtec Calculation HI-213879 stated that the distance from the ISFSI to the nearest Callaway Plant site boundary is approximately 1600 meters which exceeds the 100 meter required. This calculation presented dose rates for the individual dose rate components (neutron and gamma) at the site boundary (2080 hours/year occupancy) and nearest residence (8760 hours/year occupancy). Results are a fraction of a mrem and well below regulatory limits of 25 mrem. Section 5.0 of Callaway's 72.212 Report stated that the MPC was designed to provide confinement of all radionuclides under normal, off-normal and accident conditions, including natural phenomena. Radioactive materials stored inside the MPC will not escape to the atmosphere over the life of the ISFSI. Therefore the dose rates expected to an individual was anticipated to be well below the regulatory limits.

Documents Reviewed: a) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage System for Spent Nuclear Fuel Docket 72-1045," Revision 0; b) Holtec Calculation HI-213879, "ISFIS Site Boundary and CoC Dose Rate Calculations for the Dry Storage Project," Revision 0

Category: Radiation Protection **Topic:** Dose Rate Survey - Transfer Cask

Reference: CoC 1040, TS A.5.3.3, A.5.3.4 (b) and A.5.3.8.(c) Amendment 0

Requirement The licensee shall establish site specific dose rate limits (gamma and neutron) for the sides of the transfer cask. The licensee shall measure the surface dose rates (gamma + neutron) for each loaded transfer cask. A minimum of 4 dose rate measurements shall taken on the side of the transfer cask at mid-plane, approximately 90 degrees apart around the circumference, and between the radial ribs of the water jacket. The measured dose rate shall not exceed the licensee's site-specific surface dose rate limits as determined from Technical Specification A.5.3.3 or 3500 mrem/hr on the side, whichever is lower.

Observation: Callaway Procedure HDP-ZZ-03000, Step 6.1.1.a.1 listed a maximum average dose rate of 3,500 mrem/hr, neutron and gamma combined, on the side of the HI-TRAC VW transfer cask. Procedure Step 6.1.2.a.1 required that HI-TRAC dose rate measurements be taken at mid-height plane locations approximately 90-degrees apart on the side of the HI-TRAC between the radial ribs of the water jacket. Those procedure steps aligned with the Holtec Certificate of Compliance Technical Specification requirements of A.5.3.3, A.5.3.4 (b), and A.5.3.8(c). NRC inspectors verified this criterion was met through procedure review.

Documents Reviewed: a) Callaway Procedure HDP-ZZ-03000, Appendix H, "Spent Fuel Storage Cask Surveys," Revision 0

Category: Radiation Protection **Topic:** Neutron Dosimetry

Reference: N/A

Requirement Neutron dose rates to occupational workers should be adequately monitored.

Observation: The licensee had incorporated provisions into the health physics monitoring program to adequately monitor for both thermal and higher energy neutron spectra. The licensee used Eberline NRD Instruments (rem balls) for field neutron dose rate surveys. Mirion DMC 2000GN electronic dosimeters provided for secondary dose monitoring. The dose of record was based on Landauer Optically Stimulated Luminescent (OSL) dosimeters combined with a Neutrak 144 Dual Element CR-39 system. The licensee's calculation and analysis presented results for various dosimeters and calibration spectra related to the HAWK Tissue Equivalent Proportional Chamber (TEPC), the Mirion DMPC 2000GN Electronic Dosimeter, and the Eberline NRD Neutron Dose Rate Survey Meter. The HAWK TEPC served as a reference for true neutron dose rate. This instrument allowed for the application of appropriate International Commission Radiation Protection (ICRP) quality factors to each interaction resulting in a more accurate response. The licensee committed to continued studies during campaigns to further refine correction and calibration factors and validate assumptions and decisions made.

Documents Reviewed: a) Callaway Calculation HPCI 08-02, "Response of Callaway Neutron Dosimeters and Neutron Survey Instruments," Revision 0

Category: Radiation Protection **Topic:** Shielding Effectiveness Test

Reference: FSAR 1040, Section 10.3.ii. Revision 2

Requirement Operational neutron and gamma shielding effectiveness tests shall be performed after the first fuel loading at the host plant site using written and approved procedures. Calibrated neutron and gamma dose rate meters shall be used to measure the actual neutron and gamma dose rates at the accessible surface of the HI-STORM UMAX VVM. The test is performed to identify the expected dose levels around the VVM in order to plan for appropriate radiation protection measures for future cask loadings.

Observation: Callaway had placed the shielding effectiveness test into their site Procedure HDP-ZZ-03000, Appendix H. Procedure HDP-ZZ-03000, Appendix H, Step 6.1.2.b. contained requirements to perform a radiation survey at multiple locations around the VVM closure lid and its outlet vent ducts. Step 6.1.4.b contained instructions to evaluate the VVM survey results to determine if 10 CFR 72.104 limits would be exceeded and if appropriate radiation controls were adequate.

Documents Reviewed: a) Callaway Procedure HDP-ZZ-03000 Appendix H, "Spent Fuel Storage Cask Surveys," Revision 0

Category:	<u>Radiation Protection</u>	**Topic:**	<u>Site-Specific Dose Rate Limits - Storage Cask</u>
Reference:	CoC 1040, Tech Spec A.5.3.3 (a), A.5.3.4 (a)		Amendment 0

Requirement The licensee shall establish site-specific surface dose rate limits (gamma + neutron) for the top of the VVM. The surface dose rate limits for the storage cask may be set between the dose rate assumed in the 72.104(a) analysis and the dose rate needed to exceed the 72.104(a) dose limits, but shall not be set greater than 30 mrem/hr on the top of the VVM.

Observation: Callaway Procedure HDP-22-03000, Section 6.1.2.b.1.a requires that Tech Spec measurements be made at 4 locations taken against the outlet vent duct screen. The limits are listed in Section 6.1.1.b, combined neutron and gamma dose rates of 30 mrem/hr. Those procedure steps align with the Holtec certificate of compliance technical specification requirements of A.5.3.3 (a) and A.5.3.4 (a). NRC inspectors verified this criterion was met through procedure review.

Documents Reviewed: a) Callaway Procedure HDP-ZZ-03000, Appendix H, "Spent Fuel Storage Cask Surveys," Revision 0

Category:	<u>Radiation Protection</u>	**Topic:**	<u>Transfer Cask Surface Contamination Limit</u>
Reference:	CoC 1040, Tech Spec A.3.2.1		Amendment 0

Requirement Removable contamination on the exterior surfaces of the transfer cask and accessible portions of the canister shall not exceed 1,000 disintegrations per minute per 100 square centimeters (dpm/100 square centimeters) from beta and gamma sources and 20 dpm/100 square centimeters from alpha sources. The accessible portion of the canister is the upper portion of the canister external shell wall accessible after the inflatable annulus seal is removed and before the annulus shield ring is installed.

Observation: The contamination limits from TS A.3.2.1 of CoC 1040 had been incorporated into the licensee's procedures. Procedure HPP-2253-200, Step 7.9.11 and 7.9.14 required radiation protection group to perform contamination survey of MPC top lid surfaces and accessible areas on the MPC after the annulus seal was removed to ensure the TS 3.2.1 had been met.

The requirements in the Callaway procedures were consistent with the Holtec FW FSAR, Section 9.2.4.2, which stated that after decontaminating the canister lid top and the shell area above the annulus seal, to deflate the seal and survey the canister lid top surface and the accessible areas of the top three inches of the canister. A "Note" preceding Step 7.9.14 in HPP-2253-200 stated: "The MPC exterior shell survey is performed. Indications of contamination could require the MPC to be unloaded. In the event that the MPC shell is contaminated, users must decontaminate the annulus. If the contamination cannot be reduced to acceptable levels, the MPC must be returned to the spent fuel pool and unloaded. The MPC may then be removed and the external shell decontaininated."

Documents Reviewed: a) Holtec Procedure HPP-2253-200, "MPC Loading at Callaway," Revision 9

Category:	Records	**Topic:**	Cask Records
Reference:	10 CFR 72.234(d)(2) & (d)(3)		Published 2015

Requirement A list of records required for each cask is provided in 10 CFR 72.234(d)(2). The certificate holder is required by 10 CFR 72.234(d)(3) to provide an original of these records to the user.

Observation: The licensee was maintaining the required records in their quality related records system consistent with 10 CFR 72.234. Callaway had implemented retention of ISFSI records into their Part 50 record retention program. Callaway Procedure APA-ZZ-00209 Step 7.18.1.h. required retention of all Quality Assurance records pertaining to Callaway ISFSI Important to Safety structures, systems, and components per 10 CFR 72.174. NRC inspectors reviewed the cask records provided to Callaway per 10 CFR 72.234(d)(2) from Holtec for the first canister planned to be loaded by Callaway. The canister package contained the required information and was easily retrieved through Callaway's record retention program.

Documents Reviewed: a) Callaway APA-ZZ-00209, "Records Identification, Retention and Destruction," Revision 18

Category:	Records	**Topic:**	Notice of Initial Loading
Reference:	10 CFR 72.212(b)(1)		Published 2015

Requirement The general licensee shall notify the NRC at least 90-days prior to first storage of spent fuel.

Observation: Callaway notified the NRC by letter dated January 27, 2015, of the plans to begin fuel loading at the Callaway site on or after April 27, 2015. This notification met the requirements of the 90 day notification of initial loading required by 10 CFR 72.212(b)(1).

Documents Reviewed: a) Letter (ULNRC-06163) from David W Neterer, Vice President - Nuclear Operations Ameren Missouri, entitled "Docket Number 50-483 and 72-1045 Callaway Plant Unit 1, Union Electric Co., Facility Operating License NPF-30, 90-Day Notification Pursuant to 10 CFR 72.212(b)(1) of Intent to Load Spent Fuel Under a General License," dated January 27, 2015

Category:	Records	**Topic:**	Record Retention for 72.212 Analysis
Reference:	10 CFR 72.212(b)(5)(iii)		Published 2015

Requirement A copy of the 10 CFR 72.212 analysis shall be retained until spent fuel is no longer stored under the general license issued under 10 CFR 72.210.

Observation: Callaway had implemented retention of ISFSI records including the 10 CFR 72.212 Evaluation Report into their Part 50 record retention program. Callaway Procedure APA-ZZ-00209 Step 7.18.1.h. required retention of all Quality Assurance records pertaining to Callaway ISFSI Important to Safety structures, systems, and components per 10 CFR 72.174. Callaway generated a print-out copy of File Plan E430.0002 that documented the ISFSI records shall be retained for additional 5 years after the fuel has been transfer in accordance with 10 CFR 72.72 (d).

Documents Reviewed: a) Callaway Procedure APA-ZZ-00209, "Records Identification, Retention and Destruction," Revision 18; b) File Plans E430.0002, "ISFSI Records Retained for Department of Energy Transfer of Spent Fuel," dated 05/12/15

Category: Records **Topic:** Registration of Casks with NRC

Reference: 10 CFR 72.212(b)(2) Published 2015

Requirement The general licensee shall register the use of each cask with the NRC no later than 30 days after using the cask to store spent fuel.

Observation: The requirement to notify the NRC within 30 days of using a cask to store spent fuel was incorporated into Procedure ETP-ZZ-04021. Step 7.7.8 of the procedure, required the licensee to ensure loaded MPCs have been registered with the NRC no later than 30 days after using the cask to store fuel.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04021, "ISFSI Loading Campaign Performance IPTE," Revision 1

Category: Safety Reviews **Topic:** Changes, Tests, and Experiments

Reference: 10 CFR 72.48(c)(1) Published 2015

Requirement A licensee can make changes to their facility or storage cask design if certain criteria are met as listed in 10 CFR 72.48.

Observation: The licensee had combined the 72.48 screening and evaluation process with the 50.59 process used at the site. Procedure APA-ZZ-00143 described the screening and evaluation process for both requirements and used several different forms.

The licensee had developed classroom training material and an engineering qualification card for the 10 CFR 72.48 program. The training material provided a good description of the purpose and philosophy of the 10 CFR 72.48 process and how it related to other processes that controlled licensing basis activities at Callaway. Relevant definitions and applicable terms were provided with discussions of what they meant. The training material was well developed and very informative in assisting the user in making decisions related to the 72.48 screening and evaluation process. Examples were provided to further illustrate how to implement the process. The training material included numerous drawings and pictures describing the various components of the dry cask system specific to Callaway to help familiarize the personnel assigned to perform the screenings and evaluations with the key safety components of the various systems. The training module described the forms required and gave examples of what the various screening and evaluation criteria meant. Lessons learned at other sites relevant to the 10 CFR 72.48 process were provided.

As part of the 72.212 Evaluation Report review, NRC inspectors reviewed many 72.48 screens and three full 72.48 evaluations that related to the sites fire hazards analysis, explosion hazards, and the tornado missile analysis. The full evaluations were documented in 72.48 Evaluation Log No 15-01.

The HI-STORM UMAX FSAR documented that the fire accidents for storage were conservatively postulated to be the results of the spillage and ignition of 50 gallons of combustible transporter fuel. The Callaway site specific analysis evaluated a fire due to the Low Profile Transporter (HI-PORT), tracked Vertical Cask Transporter (VCT), and an Arial Work Platform (JLG) boom lift. The fire specific analysis was documented in Holtec Report HI-2156590. The fire accident was evaluated using the same methodology as in the FSAR. The results of the analysis concluded that the combined combustible liquids from the above listed equipment would not cause fuel assemblies to exceed peak cladding temperatures above the FSAR allowable accident limits of 570 degrees C.

The explosion hazard documented in the FSAR, found the UMAX was qualified to a 10 psi overpressure. Due to the location of the ISFSI within the Protected Area, Callaway requested that the UMAX be reviewed and qualified for an overpressure of 20 psi. The explosion impacts from Callaway were documented in Holtec Report HI-2146196. The Callaway site-specific explosion hazards were evaluated and determined that the overpressure wave did not result in lid separation and that all lid stresses were a fraction of the allowable limits.

The tornado missile analysis contained in the FSAR did not bound all the missiles contained in the Callaway's Part 50 UFSAR Table 3.5-1. As a result, a site specific analysis was performed using a different set of missiles to bound Callaway's design basis missiles. The tornado missile analysis was documented in Holtec Report HI-2146196. The specific analysis utilized the same methodology as performed in the Holtec UMAX FSAR. The kinetic energy generated by the Callaway Part 50 design basis missiles was bounded by the kinetic energy input values generated from the new list of bounding missiles that were presented in the analysis. It was found that the new bounding missiles did not breach the confinement boundary, locally deform the cask such that the retrievability of the MPC was threatened, or deform the cask plastically such that the shielding effectiveness was affected.

All three evaluations were performed using the original methodology and acceptance criteria, and found that the original acceptance criteria was still met. The evaluations documented that the site specific conditions did not result in more than a minimal increase in the frequency or likelihood of any accident or malfunction, or consequences of an accident or malfunction. The site specific evaluations also did not create the possibility of a different type of accident or malfunction, cause a design basis limit for a fission product barrier to be exceeded or altered, or result in a change in methodology. Therefore the 72.48 evaluation concluded the activity can be implemented without requesting a CoC Amendment.

Documents Reviewed: a) Callaway Procedure APA-ZZ-00143, "10 CFR 50.59 and 10 CFR 72.48 Reviews," Revision 16; b) Training Course Number T62.06496, "10 CFR 72.48 "Evaluator Initial Training," Date 01/17//2015; c) Callaway Engineering Qualification Standard, "Prepare a 10 CFR 72.48 Screening and Evaluation," Date 12/10/14; d) 72.48 Evaluation Log No. 15-01, "MP 14-0014, Dry Fuel Storage Licensing and Operations Documentation," Revision 0; e) Holtec Report HI-2146196, "Evaluation of Plant Hazards at Callaway Energy Center," Revisions 2, 3, and 4; f) Holtec Report HI-2156590, "Evaluation of Combined Effect of HI-PORT and VCT Fires on HI-TRAC at Callaway," Revisions 0 and 1; g) Holtec Report HI-2135677, "Evaluation of Effects of Tracked VCT Fire on HI-STORM FW System," Revision 5; h) 10 CFR 72.212 Evaluation Report, "Callaway Plant, Unit 1, Dry Fuel Storage System for Spent Nuclear Fuel Docket 72-1045," Revision 0

Category: Slings **Topic:** Sling Heavy Load Requirements

Reference: NUREG 0612, Section 5.1.6 (1) (b) Published July 1980

Requirement Dual or redundant slings should be used such that a single component failure or malfunction in the sling will not result in an uncontrolled lowering of the load, OR the load rating of the sling should be twice the sum of the static and dynamic loads.

Observation: Dual and redundant slings were used to download the canister from the transfer cask into the HI-STORM UMAX. The load rating on the slings was twice the weight of the static and dynamic loads of the canister. The slings purchased at Callaway had a vertical rating of 140,000 pounds each. Two of these slings are required for downloading the canister. The fully loaded canister was calculated to be 97,288 pounds per Holtec Document HI-2146011 (Case 6). A conservative static value of 120,000 pounds was used in the calculation of Purchase Specification PS-1234 for purchase of the slings. A dynamic load of 15% was added to the static load providing a total of 140,000 pounds. Redundant slings were used in the vertical formation. The minimum vertical rated capacity of each sling was calculated to be 140,000 pounds. The slings that were purchased by Callaway were rated at 140,000 lb (vertical rated) capacity (TPSE-EE14000 - 62.5ft Twin-Path Spark-eater eye & eye slings).

NRC inspectors reviewed the purchase specifications for the slings utilized in lifting the MPC lid, lifting the gate adapter, lifting the closure lid, and other miscellaneous slings utilized throughout the campaign. Dual and redundant slings were used in all heavy load lifts associated with the loading operations.

Documents Reviewed: a) Holtec Report HI-2146011, "Cask Handling Weights at Callaway," Revision 1; b) Holtec PS-1234, "Purchase Specification for the MPC Downloading Slings for Downloading Using the VCT," Revision 4; c) Holtec PS-3200, "Purchase Specification for the HI-STORM FW System Multi-Purpose rigging system," Revision 3

Category: Slings **Topic:** Sling Identification

Reference: ASME B30.9, Section 9-5.1.6 Published 1990

Requirement Each sling should be permanently marked to show: (a) name or trademark of manufacturer; (b) manufacturer's code or stock number; (c) rated loads (rated capacities) for the types of itches used; (d) type of natural or synthetic material;

Observation: NRC inspectors visually inspected slings during the outside pad operations dry-run, from July 14-17, 2015. All inspected steel wire rope and synthetic fiber slings were tagged with information including manufacturer, rated load capacity, serial number, and type of material.

Documents Reviewed: N/A.

Category: Slings **Topic:** Sling Inspections - Frequent

Reference: ASME B30.9, Section 9-4.7.1 (b) Published 1990

Requirement A visual inspection for damage shall be performed each day or shift the sling is used.

Observation: Callaway's rigging procedure contains the routine inspection criteria for wire rope and synthetic slings. According to the procedure, slings were to be inspected for all manner of wear and tear, including burns, missing tags, holes, cuts, etc on a daily basis. NRC inspectors noted that slings were inspected during dry-run activities and during the initial cask loading operations at Callaway. The licensee had established training and procedures to ensure that slings would be properly inspected prior to use during fuel loading operations for the Callaway ISFSI.

Documents Reviewed: a) Holtec Report No.: HI-2135598, "MPC Lift Sling Operations and Maintenance Manual," Revision 0; b) Callaway Procedure APA-ZZ-00365, Addendum R, "Callaway Rigging Operations," and Attachment 4, "Portable Hoist and Come-along Frequent Inspections," Revision 1

Category: Slings **Topic:** Sling Inspections - Periodic

Reference: ASME B30.9, Section 9-4.7.1 Published 1990

Requirement A complete inspection for damage to the sling shall be conducted at intervals not to exceed one year.

Observation: A complete inspection of slings was completed on an annual basis for the slings utilized in the Callaway loading campaign. All slings and wire ropes utilized in the Callaway loading operations were owned and controlled by Holtec. Holtec Procedure HSP-410 was utilized to perform the annual inspections. The NRC inspector confirmed that all slings used during the first canister loading operations were within their annual inspection dates by visual examination of sling equipment identification tags.

Documents Reviewed: a) Holtec Procedure HSP-410, "NUREG-0612 Periodic Maintenance Program: Control of Slings, Hooks, Misc. Tackle and Structural and Mechanical Lifting Devices," Revision 0

Category: Slings **Topic:** Sling Load Rating

Reference: NUREG 0612, Section 5.1.1 (5) Published July 1980

Requirement In selecting the proper sling, the load used should be the sum of the static and maximum dynamic load. The rating identified on the sling should be in terms of the "static load" which produces the maximum static and dynamic load.

Observation: All slings utilized at Callaway were selected in accordance with the NUREG 0612 requirements. NRC inspectors reviewed the Purchase Specifications for the slings utilized in downloading the MPC, lifting the MPC lid, lifting the gate adapter, lifting the closure lid, and other misc. slings utilized throughout the campaign. The documents demonstrated the slings selected were based on the sum of the static and dynamic loads. NRC inspectors inspected the slings that were utilized in the campaign and confirmed that the slings met the Purchase Specifications.

Documents Reviewed: a) Holtec PS-1234, "Purchase Specification for the MPC Downloading Slings for Downloading Using the VCT," Revision 4; b) Holtec PS-3200, "Purchase Specification for the HI-STORM FW System Multi-Purpose rigging system," Revision 3

Category: Slings **Topic:** Sling Proof Loading

Reference: ASME B30.9, Section 9-5.4 Published 1990

Requirement When specified by the purchaser, slings of all types shall be proof loaded. The proof load for single leg (branch) slings and endless slings shall be two times the vertical rated load (rated capacity).

Observation: Holtec Purchase Specification, Section 8, "Inspections and Testing Requirements," required that a proof test of twice the rated vertical capacity be applied to all load bearing components of the MPC downloading ancillary. The certificate of conformance from I&I Slings showed that two slings, serial numbers P102114094 and P102114095, were proof tested to twice their rated load of 140,000 lbs., in accordance with ASME 30.9 standards. This criteria was satisfactorily demonstrated by documents review by NRC inspectors during dry-run activities and first loading at Callaway for its Holtec UMAX ISFSI.

Documents Reviewed: a) Holtec International Purchase Specification PS-1234, "Purchase Specification for the MPC Downloading Sling for Downloading using the VCT," Revision 4; b) Holtec International COC-14311-002, "Certificate of Conformance," Revision 0

Category: Slings **Topic:** Sling Temperature Limits

Reference: No Reference Provided N/A

Requirement Synthetic slings shall not be used in contact with objects that exceed the temperature limit of the sling.

Observation: NRC inspectors verified that a maximum allowable sling to MPC contact temperature had been established for cask loading operations at the Callaway ISFSI. The synthetic MPC lift slings used at Callaway had a specified maximum contact temperature for the synthetic sling of no more than 300 degrees F in both the Holtec Report and Holtec's procedure for use at Callaway.

Documents Reviewed: a) Holtec Report No.: HI-2135598, "MPC Lift Sling Operations and Maintenance Manual," Revision 0; b) Holtec Procedure HPP-2253-400, "MPC Transfer for Callaway," Revision 7

Category: Slings **Topic:** Synthetic Round Sling Removal from Service

Reference: ASME B30.9, Section 9-4.8 Published 1990

Requirement A synthetic round sling shall be removed from service if any of the following conditions are present: (a) cuts, gouges, badly abraded spots; (b) seriously worn surface fibers or yarns; (c) considerable filament or fiber breakage along the line where adjacent strands meet (light fuzzing is acceptable); (d) particles of broken filament or fibers inside the rope between the strands (inspect inside the rope); (e) discoloration or harshness that may mean chemical damage or excessive exposure to sunlight. Inspect filaments or fibers for weakness or brittleness; (f) kinks or hockles; (g) melting or charring on any part of the sling; (h) excessive pitting or corrosion, or cracked, distorted or broken fittings; (i) other visible damage that causes doubt as to the strength of the sling

Observation: The synthetic round sling inspection criteria, consistent with the key elements of ASME B30.9, was listed in Procedure HSP-410. All slings and wire ropes utilized in the Callaway loading operations were owned and controlled by Holtec. The Holtec Procedure HSP-410 contained the ASME B30.9 removal criteria in Section 6.3.6. The NRC inspectors confirmed that all slings used during the first canister loading operations were within their annual inspection dates.

Documents Reviewed: a) Holtec Procedure HSP-410, "NUREG-0612 Periodic Maintenance Program: Control of Slings, Hooks, Misc. Tackle and Structural and Mechanical Lifting Devices," Revision 0

Category: Slings **Topic:** Wire Rope Sling Removal From Service

Reference: ASME B30.9, Section 9-2.8.3 Published 1990

Requirement A wire rope sling shall be removed from service if any of the following conditions are present: (a) for strand laid and single part slings ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay; (b) severe localized abrasion or scraping; (c) kinking, crushing, birdcaging or any other damage resulting in distortion of the rope structure; (d) evidence of heat damage; (e) end attachments that are cracked, deformed, or worn to the extent that the strength of the sling is substantially affected; (f) severe corrosion of the rope or end attachments;

Observation: The wire rope sling inspection criteria, consistent with the key elements of ASME B30.9, was listed in Procedure HSP-410. All slings and wire ropes utilized in the Callaway loading operations were owned and controlled by Holtec. The Holtec Procedure HSP-410 contained the ASME B30.9 removal criteria in Section 6.3.5. The NRC inspectors confirmed that all slings used during the first canister loading operations were within their annual inspection dates.

Documents Reviewed: a) Holtec Procedure HSP-410, "NUREG-0612 Periodic Maintenance Program: Control of Slings, Hooks, Misc. Tackle and Structural and Mechanical Lifting Devices," Revision 0

Category: Special Lifting Device **Topic:** Lifting Device's Annual Testing

Reference: ANSI N14.6, Sect 7.3.1; Sect 6.3.1 Published 1993

Requirement Annually, not to exceed 14 months, all special lifting devices shall be subjected to a test load equal to 300% of the maximum service load if a single component failure on the device could result in an uncontrolled lowering of the load. If the design for handling the load incorporates a single-failure proof concept, then each path in the dual-load-path device shall be tested to 150% of the load instead of the 300%. After sustaining the load for a period of not less than 10 minutes, critical areas, including major load bearing welds, shall be subject to visual inspection for defects and all components shall be inspected for permanent deformation. In cases where surface cleanliness and conditions permit, the load testing may be omitted and dimensional testing, visual inspection and nondestructive testing of major load-carrying welds and critical areas shall suffice.

Observation: Callaway/Holtec equipment had recently performed the initial load tests and NDE examinations for the lift yoke, yoke extension, HI-TRAC VW lifting lugs, MPC lift cleats, and the VCT lift links for the current year. NRC inspectors reviewed two worksheets that were produced for recording/tracking future test results for the Callaway owned equipment. Both Callaway owned and Holtec owned equipment's' preventative/routine maintenance procedures had not been fully developed at the time of the initial loading inspection. This will be a follow-up item to be reviewed in future inspections at Callaway.

Documents Reviewed: a) Callaway Worksheets PM15506409, "Lift Yoke Annual Load Test," Revision 0; b) PM15506408, "Lift Yoke Extension Annual Load Test," Revision 0

Category: Special Lifting Device **Topic:** Lifting Device's Initial Acceptance Testing

Reference: ANSI N14.6, Sect 7.3.1; Sect 6.2.1; Sect 6.5 Published 1993

Requirement Prior to initial use, the yoke shall be subjected to a test load equal to 300% of the maximum service load if a single component failure on the yoke could result in an uncontrolled lowering of the load. If the design for handling the load incorporates a dual-load-path concept, then each path in the dual-load-path device shall be tested to 150% of the load instead of the 300%. After sustaining the load for a period of not less than 10 minutes, critical areas, including load bearing welds, shall be subject to nondestructive testing using liquid penetrant or magnetic particle examination.

Observation: NRC inspectors reviewed load test procedures and acceptance testing results for the Lift Yoke, S/N: 702-0872-8851-1000-1; Lift Yoke Extension, S/N: 0929-878+91000-1-A; Lift Lug S/Ns: 723-006 "G" and 723.-010 "H;" and the MPC Lift Cleats and Shielding, S/N: 209-98131000-1. Those load tests included the results of hydraulically simulated loads of 300% the maximum rated load capacity, as specified by Holtec Procedure HSP-706. The inspection criteria included sustaining the simulated load for a minimum of ten minutes followed by dimensional measurements, which were at specified locations, pre and post load test. The inspection also called for visual testing and non-destructive testing of the special lifting devices and those results were also shared with the NRC. The lift yoke, lift yoke extension, both lift lugs, and the MPC lift cleats all passed the load, dimensional, and nondestructive testing that was required by ANSI N 14.6.

Documents Reviewed: a) Holtec Purchase Specification PS-3702, "Purchase Specification for the HI-TRAC VW Lift Yoke," Revision 5; b) Holtec Procedure HSP-706, "HI-TRAC VW Lift Yoke/Lift Lugs Load Test Procedure," Revision 2; c) Holtec Procedure HPP-2253-06, "Lift Yoke Extension Factory Acceptance Test," Revision 0; d) Holtec PS-3701, "Purchase Specification for the HI-TRAC VW Lift Links," Revision 2; e) Holtec Report No: HI-2135597, "MPC Lift Cleats Operation and Maintenance Manual," Revision 0; f) Holtec Procedure HPP-2253-06, "Lift Yoke Factory Acceptance Test," dated January 20, 2015; g) Holtec Procedure HSP-710, "MPC FW Lift Cleat Load Test Procedure," Revision 4

Category: Special Lifting Device **Topic:** Lifting Device's Stress Design -Dual-Load-Path

Reference: ANSI N14.6, Sect 4.2.1.1; Sect 4.1.3; Sect 7.2.3 Published 1993

Requirement For yokes that are single failure proof by having dual-load-path attachments, the load bearing members of the yoke shall be capable of lifting three (3) times the combined weight of the shipping container plus the weight of the intervening components of the special lifting device, without generating a combined shear stress or maximum tensile stress at any point in the device in excess of the corresponding minimum tensile yield strength of the material of construction. They shall also be capable of lifting five (5) times the weight without exceeding the ultimate tensile strength of the materials. The dual load-path attachment points on the yoke shall be designed such that each load path will be able to support a static load of three (3) times the weight of the critical load, including intervening components of the lifting device.

Observation: The lift yoke, as well as, the yoke extension, the HI-TRAC VW Lifting Lugs, the MPC lift cleats, the VCT lift links, and the transporter's pulley system used to download the MPC were all designed in accordance with the ANSI N14.6 standard and NUREG 0612 requirements. Stress reports and design specifications for each lifting device were reviewed to confirm the ANSI and NUREG design requirements were properly specified. Additionally, the NRC inspectors reviewed the bill of materials specified on the design drawing or in the components' documentation packages to confirm the components were fabricated from the same material as specified in the purchase specifications and stress reports.

Documents Reviewed: a) Holtec DOC-104-702-037, "HI-TRAC VW Lift Yoke for Callaway," Revision 0; b) Holtec Drawing 2253-8851, "Assembly of Lift Yoke HI-TRAC VW," Revision 1; c) Holtec Drawing 104-8997, "HI-TRAC VW Lift Link," Revision 4; d) Holtec PS-1120, "Purchase Specification for the Vertical Cask Transporter," Revision 6; e) Holtec PS-3702, "Purchase Specification for the HI-TRAC VW Lift Yoke," Revision 5; f) Holtec Report HI-2146172, "Structural Analysis of HI-TRAC VW Lift Yoke," Revision 0; g) Holtec PS-3723, "Purchase Specification for the HI-TRAC VW Lifting Lugs," Revision 4; h) Holtec PS-3117, "Purchase Specification for the HI-TRAC VW Lift Yoke Extension," Revision 2; i) Holtec Report HI-2146002, "Structural Evaluation of Lift Yoke Extension at Callaway," Revision 1; j) Holtec Report HI-2135524, "Structural Analysis of the HI-TRAC VW Lift Links (250,000lbs Capacity)," Revision 1; k) Holtec PS-3701, "Purchase Specification for the HI-TRAC VW Lift Links," Revision 2; l) Holtec Report HI-2125307, "Structural Analysis of HI-TRAC VW Lift Lug," Revision 4

Category: Special Lifting Device **Topic:** Special Lifting Devices Inspection Prior to Use

Reference: ANSI N14.6, Sect 6.3.6 Published 1993

Requirement The yoke shall be visually inspected by operating personnel for indications of damage prior to each use.

Observation: Prior to use inspections steps were placed in Callaway's loading procedures prior to rigging any of the special lifting devices used during the ISFSI loading operations. This included the yoke, yoke extension, HI-TRAC VW lift lugs, MPC cleats, and VCT lift links.

Documents Reviewed: a) Procedure HPP-2253-200, "MPC Loading at Callaway," Revision 9; b) Procedure HPP-2253-400, "MPC Transfer at Callaway," Revision 7

Category: Special Lifting Device **Topic:** Transporter Initial Acceptance Testing

Reference: ANSI N14.6, Sect 7.3.1; Sect 6.2.1; Sect 6.5 Published 1993

Requirement Prior to initial use, the special lifting device shall be subjected to a test load equal to 300% of the maximum service load if a single component failure on the yoke could result in an uncontrolled lowering of the load. If the design for handling the load incorporates a single-failure proof concept, then each path in the dual-load-path device shall be tested to 150% of the load instead of the 300%. After sustaining the load for a period of not less than 10 minutes, critical areas, including load bearing welds, shall be subject to nondestructive testing using liquid penetrant or magnetic particle examination.

Observation: Review of the factory acceptance test documentation showed that the VCT used by Callaway for its initial ISFSI campaign had met all of the regulatory requirements. The Vertical Cask Transporter (VCT) used at Callaway for transfer of the MPC from the fuel building to the ISFSI pad had its initial acceptance testing performed on April 9 and 10, 2015. NRC inspectors reviewed the test records that documented the 125% static load test, 100% dynamic load and operational test, 150% MPC downloader system test, initial and post-test non-destructive examination (NDE), and others.

Documents Reviewed: a) Holtec Procedure HSP-199, "VCT Factory Acceptance Test Procedure," Attachment 7.1, "FAT [Factory Acceptance Test] and Sign-offs," Revision 2

Category: Special Lifting Device **Topic:** Transporter Inspection - Quarterly

Reference: ANSI N14.6, Sect 6.3.7 Published 1993

Requirement Special lifting devices shall be visually inspected by maintenance or other non-operating personnel at intervals not to exceed three months in length for indications of damage or deformation.

Observation: Callaway's Procedure ETP-ZZ-04021 had included acceptance criteria for vendor owned (Holtec) special lifting devices in Step 7.1.12 for the HI-TRAC lift lugs and Step 7.1.28 for the MPC lid lift cleats, which included making sure that all periodic maintenance and checks had been performed. This procedure also included the Callaway owned special lifting devices of the lift yoke and lift yoke extension in Step 7.1.19. NRC inspectors reviewed the quarterly preventative maintenance worksheets for both the lift yoke and lift yoke extension. NRC verified that all of the proper procedures and supporting documents were in place to support the quarterly visual inspection of special lifting devices or to check to insure that vendor supplied special lifting devices had been properly tested prior to use at Callaway.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04021, "ISFSI Loading Campaign Performance – IPTE (Infrequently Performed Tests and Evolutions)," Revision 0

Category: <u>Storage Operations</u> **Topic:** <u>Storage Cask Temperature Monitoring</u>

Reference: CoC 1040, Tech Spec A.3.1.2 Amendment 0

Requirement Verify all VVM outlet air ducts are free of blockage from solid debris or floodwater every 24 hours, OR for VVMs with installed temperature monitoring equipment, verify that the difference between the average VVM air outlet temperature and ISFSI ambient temperature is less than or equal to 80 degrees F every 24 hours for storage casks containing PWR canisters.

Observation: The licensee planned to conduct vent screen daily observations per operator rounds procedure ODP-ZZ-0016E, Appendix 1, Point ID OPS 02174. If debris was found, the operator would clear the debris from the vents. If the clearance could not be accomplished by hand, a work order would be created to clear the debris. Results were communicated to a licensed operator who documented the results in OSP-ZZ-00001, Attachment 4 and in the Operator Log. If there was a blockage, OSP-ZZ-00001 directed the operator to review the applicable Technical Specification for applicability.

Documents Reviewed: a) Callaway Procedure ODP-ZZ-0016E Appendix 1, "Inside Operator Rounds," dated 06/29/2015; b) Callaway Procedure OSP-ZZ-00001, "Control Room Shift and Daily Log Readings and Channel Checks," Attachment 4, Revision 85

Category: <u>Storage Operations</u> **Topic:** <u>Thermal Acceptance Test</u>

Reference: FSAR 1040 Section 10.3.iii Revision 2

Requirement A thermal acceptance test shall be performed on the first fully loaded VVM assembly whose aggregate MPC heat load is at least 50% of the Design Basis maximum heat load per the system CoC.

Observation: Callaway placed limits on their first campaign's canisters' heat loads to ensure all MPCs would have a heat load below 50% of the Design Basis maximum. By placing this restriction, Callaway would not be required to perform the Heat Transfer Validation Test. Callaway Procedure ETP-ZZ-04020 Section 5.1, noted that the aggregate heal load of the loaded elements will not exceed 33.88 KW which is 80 percent of the design basis limit of 43.5 kW. A note in the Section 5.1 listed 21.75 kW as the threshold for when a thermal performance test would be required.

Table 8-8H of Procedure ETP-ZZ-04020, provided decay heat load for selected elements including inserts and approved MPC Regions for loading. Attachment 1 to the procedure provided fuel assembly identification numbers, insert identification numbers, decay heat rate per assembly, assembly burnup, spent fuel pool location prior to loading operations, the cell location in the MPC into which the assembly is to be loaded, the decay heat limit for the specified MPC cell, and the MPC cell allowed inserts for the six canisters that were to be loaded in the first campaign.

The licensee completed a two party compliance checklist for each MPC loaded in the campaign. The checklist verified that all assemblies met the MPC cell decay heat limit, that the total heat load was less that 21.75 kW, the all assembly burnups were equal to or less than 68,200 MWD/MTU, that all fuel assemblies are Westinghouse 17X17 Zr clad assemblies, that all assemblies have been discharged for more than 3 years, that all fuel assemblies are approved for the designated MPC region, the MPC contained no nuclear source assemblies, that RCCAs were only placed in cells 5 through 7, 10 through 14, 17 through 21, 24 through 28 and 31 through 33, that BRPA maximum burnup was 60,000 MWD/MTU and that RCCA and Thimble plug maximum burnup is 630,000 MWD/MTU. Review of the data supplied for each MPC loading indicated that applicable limits were met.

Documents Reviewed: a) Callaway Procedure ETP-ZZ-04020, "Fuel Selection and Cask Loading for Dry Cask Storage," Revision 0; b) Cask Loading Plan, Attachment 1 to ETP-ZZ-04020, Revision 0, for MPC# HGMPC0037,HGMPC0038, HGMPC0039, HGMP0040, HGMP0041, HGMP0042

Category: Storage Operations **Topic:** VVM Vent Screen Inspections

Reference: FSAR 1040, Table 10.4.1 Revision 2

Requirement The VVM vent screens shall be visually examined for damage monthly.

Observation: The licensee incorporated the FSAR requirement to perform monthly visual examinations of the VVM vent screens into the Preventative Maintenance system as PM # 1008329. This maintenance item required a monthly visual check of the VVM screens for damage and accessible VVM areas for long term degradation.

Documents Reviewed: a) Callaway PM #1008329, "VVM Monthly Inspections," Revision 0

Category: Unloading Operations **Topic:** Canister Gas Sampling

Reference: FSAR 1032, Section 9.4.3.4 Revision 3

Requirement During unloading of a cask, gas sampling is performed to assess the condition of the fuel assembly cladding. The gas sample bottle is connected to the vent port RVOA and the RVOA body and sample bottle are evacuated. The vent port cap is then slowly opened using the RVOA, and the gas sample is obtained.

Observation: Callaway demonstrated the ability to draw a gas sample from a canister during the fluid operations dry run that was conducted on June 2-4, 2015. Callaway would utilize Procedure CSP-ZZ-07046 to obtain a gas sample if the licensee was required to unload an MPC. The procedure addressed ALARA concerns that could develop when performing the activity.

Documents Reviewed: a) Callaway Procedure CSP-ZZ-07046, "MPC Boron and Gas Activity," Revision 0

Category: Unloading Operations **Topic:** Canister Reflooding

Reference: FSAR 1032, Section 9.4.3.5.c. Revision 3

Requirement Reflood the canister slowly with a pressure of less than 90 psi through the drain port until bubbling from the vent line has terminated.

Observation: Reflooding of a canister would be performed through the drain port at a pressure of less than 90 psig. Procedure HPP-2253-500, Step 7.10.12 described commencing the reflooding of the canister. A note above that step required monitoring the pressure gage to ensure the MPC remained less than 90 psig. Attachment 8.8 of the procedure contained the MPC reflood arrangement diagram that showed water would enter the MPC via the drain port.

Documents Reviewed: a) Holtec Procedure, HPP-2253-500 "MPC Unloading at Callaway," Revision 7

Category: Unloading Operations **Topic:** Hydrogen Monitoring

Reference: FSAR 1032, Table 9.1.1 Revision 3

Requirement To preclude the potential for hydrogen ignition during lid cutting, operating procedures require monitoring for combustible gas and purging the space beneath the canister lid with an inert gas.

Observation: Hydrogen monitoring was required during lid cutting operations and was incorporated into the weld cutting dry run that took place at Holtec HMD facility on June 16-18, 2015. NRC inspectors observed the weld cutting dry run and use of the hydrogen monitoring system. Holtec procedure HPP-2253-500 required continuous monitoring for hydrogen during cutting operations in Step 7.13.21. Personnel were required to record the hydrogen levels in Attachment 8.14, "MPC Combustible Gas Monitoring and Argon Purge Log," every 20 minutes during the duration of the cutting evolution until cutting was complete.

Documents Reviewed: a) Holtec Procedure HPP-2253-500, "MPC Unloading at Callaway," Revision 7

Category: Welding **Topic:** Closure Ring, Vent and Drain Port Plate Weld PT

Reference: CoC 1040, Appendix B, Table 3-1 Amendment 0

Requirement A liquid penetrant (PT) examination is required on the root (if more than one weld pass is required) and the final pass on the vent and drain port cover plate welds. The PT examination shall be performed in accordance with NB-5245.

Observation: The PCI project instruction, in the steps under section 9.0, established a process for examining and documenting the acceptability of all levels of welding taking place to secure the closure lid and port vent cap lids to the Holtec Multi-Purpose Canister. Those steps of the instruction direct a liquid dye penetrant test after the root and other closure passes, after hydro testing, and prior to helium leak testing for the drain port cover plates. The NDE examinations for all sections of the final closure welds were spelled out by procedure and instructions. The PCI procedure satisfied the criteria set forth in CoC 1040 regarding PT of the closure lid, rings, and vent port caps.

Documents Reviewed: a) PCI Project Instruction PI-CNSTR-OP-CAL-H-01, "Closure Welding of Holtec Multi-Purpose Canisters – UMAX," Revision 1

Category: Welding **Topic:** Combustible Gas Monitoring

Reference: CoC 1040, Appendix B, Section 3.5 Amendment 0

Requirement During canister lid-to-shell welding operations, combustible gas monitoring of the space under the lid is required to ensure that there is no combustible gas mixture present in the welding area.

Observation: The requirement to monitor the space under the lid for combustible gases (hydrogen) was covered in the PCI procedure for the closure welding of the MPC in Step 8.3.4 which calls for hydrogen monitoring the be performed until the lid-to-shell weld has been completed. PCI had procedures in place that met the combustible gas monitoring requirement as called out in the Holtec CoC 1040.

Documents Reviewed: a) PCI Project Instruction, PI-CNSTR-OP-CAL-H-01, "Closure Welding of Holtec Multi-Purpose Canisters – UMAX," Revision 1

Category: Welding **Topic:** Control of Weld Filler Materials

Reference: 10 CFR 72.154 Published 2015

Requirement The licensee shall establish measures to ensure that purchased material, equipment, and services conform to procurement documents. These measures must include provisions for source evaluation and selection, objective evidence of quality furnished by the contractor/subcontractor, inspection at the contractor/subcontractor source and examination of product on delivery. Records shall be available for the life of the ISFSI. The effectiveness of the control of quality by contractors/subcontractors shall be assessed at intervals consistent with the importance, complexity and quantity of the product or service.

Observation: PCI had established for Callaway a procedure for control of weld wire and other materials that met the applicable requirements of 10 CFR 72.154. PCI Procedure GQP-7.1 covered the procurement, receipt, storage, and issuance requirements for weld and fill materials to be used in support of dry fuel storage operations at Callaway. WCP-3 implemented the security and storage requirements of NUREG/CR-6314 Section 4.3.2.1.2 (6) (d) in its Section 8, "Storage and Disbursement Areas." This section of the PCI procedure specified how welding filler materials, electrodes, and other materials shall be stored and accessed by PCI welders and others who needed to access these materials.

Documents Reviewed: a) PCI Procedure GQP-7.1, "Procurement, Receipt, Storage, and Issue of ASME III, Subsection NCA 3800 Weld Materials," Revision 7; b) PCI Welding Control Procedure, WCP-3, "Weld Material Control," Revision 0

Category: Welding **Topic:** Minimum Delta Ferrite Content

Reference: ASME Section III, Article NB-2433; Reg Guide 1.31 Published 2007

Requirement A delta ferrite determination must be made for A-No.8 consumable inserts, bare electrode, rod, or wire filler metal. Exceptions: 1) A-No.8 metal used for weld metal cladding; 2) SFA-5.4 and SFA-5.9 metal; 3) Type 16-8-2 metal. The minimum acceptable delta ferrite content is 5 FN and it must be stated in the certification records.

Observation: The ferrite number for all of the inspected certified mill test results (CMTRs) were above the required number of 5 FN. The weld filler material's CMTRs inspected by the NRC all exceeded the minimum code requirements.

Documents Reviewed: a) PCI Certificate of Conformance 907864-01; b) ARCOS Certified Material Test Report for PCI purchase order, PO# 4500651885

Category: <u>Welding</u> **Topic:** <u>Procedure Qualification Record (PQR)</u>

Reference: ASME Section IX, Part QW-200.2 Published 2007

Requirement Each manufacturer or contractor shall prepare a Procedure Qualification Record (PQR) for each procedure. The completed PQR shall document all essential and, when required, all supplementary essential variables of QW-250 through QW-280 for each welding process used during the welding of the test coupon. Non essential variables may be documented at the contractor's option. The PQR shall be certified accurate by the manufacturer or contractor.

Observation: PCI, the welding contractor for Callaway, had prepared the Procedure Qualification Records with the required information for each welding procedure. The procedure qualification records (PQR-062, PQR-063, PQR-600, PQR-864, and PQR-899) for Weld Procedure Specifications (WPS) 8-MC-GTAW and 8 MN-GTAW listed the proper essential, supplementary, and non-essential variables, as specified in ASME Section IX, Part QW-200.2

Documents Reviewed: a) PCI PQR-062, Revision 3; b) PCI PQR-600, Revision 6; c) PCI PQR-864, Revision 2; d) PCI PQR-899, Revision 0; e) PCI PQR-063, Revision 6; f) PCI WPS 8-MC-GTAW, Revision 15; g) PCI WPS 8 MN-GTAW, Revision 3

Category: <u>Welding</u> **Topic:** <u>Procedure Qualification Tests</u>

Reference: ASME Section III, Article NB-4331 Published 2007

Requirement All welding procedure qualification tests shall be in accordance with the requirements of Section IX. ASME Section IX Article II QW-202.2 (b) requires partial penetration groove welds to be qualified in accordance with the requirements of QW-451. QW-202.2 (c) states that welding procedure specification (WPS) qualification for fillet welds may be made on groove-weld test coupons using test specimens specified in (b) above.

Observation: The procedure qualification records (PQR-062, PQR-063, PQR-600, PQR-864, and PQR-899) test coupons, which qualified Welding Procedure Specifications 8-MC-GTAW and 8-MN-GTAW, all satisfactorily passed the required tests per Table QW-451.1 "Groove - Weld Tension Tests and Transverse-Bend Tests."

Documents Reviewed: a) PCI PQR-062, Revision 3; b) PCI PQR-600, Revision 6; c) PCI PQR-864, Revision 2; d) PCI PQR-899, Revision 0; e) PCI PQR-063, Revision 6; f) PCI WPS 8-MC-GTAW, Revision 15; g) PCI WPS 8 MN-GTAW, Revision 3

Category: <u>Welding</u> **Topic:** <u>Tack Welds</u>

Reference: ASME Section III, Article NB-4231.1 Published 2007

Requirement Tack welds used to secure alignment shall either be removed completely when they have served their purpose, or their stopping and starting ends shall be properly prepared by grinding or other suitable means so that they may be satisfactorily incorporated into the final weld. When tack welds are to become part of the finished weld, they shall be visually examined and defective tack welds shall be removed.

Observation: NRC reviewed PCI's general welding procedure and found that it did not explicitly address the incorporation of tack welds into the final weld by grinding or other suitable means. This was taken and placed into the Callaway corrective action program as CAR

201501626. The licensee decided that language would be adopted and placed into the general welding standard to address this shortcoming. Language was added to Step 7.2.5 in Revision 1 of the PCI procedure for closure welding of Holtec MPCs, directing that tack weld starts and stops should be "ground" or "feathered" for suitable incorporation into the final weld.

Documents Reviewed: a) PCI General Welding Standard - 1 (GWS-1), Revision 0; b) PCI Project Instruction PI-CNSTR-OP-CAL-H-01, "Closure Welding of Holtec Multi-Purpose Canisters – UMAX," Revision 1

Category: Welding **Topic:** Weld Repairs - Base Metal Defects

Reference: ASME Section III, Article NB-4132 Published 2007

Requirement Weld repairs exceeding in depth the lesser of 3/8 inch (10 mm) or 10 percent of the section thickness, shall be documented on a report which shall include a chart which shows the location and size of the prepared cavity, the welding material identification, the welding procedure, the heat treatment, and the examination results of the weld repair.

Observation: This requirement was met. PIC Weld Control Procedure, WCP-5, did not reference ASME Section III, Article NB-4132 as a standard, nor did it include the requirements that all weld repairs exceeding 3/8 inch or 10 percent of the section thickness shall be documented on a report that includes a chart showing the location and size of the prepared cavity, weld material identification, procedure and examinations results of the weld repair. This issue was addressed in a revision to PCI Project Instruction PI-CNSTR-OP-CAL-H-01. Revision 1 of the Procedure PI-CNSTR-OP-CAL-H-01 in Step 7.2.6 included wording to align the weld repair criteria at Callaway with the ASME code document. In addition, the base metal and weld repair worksheet, Attachment 10, of that instruction was updated, as well.

Documents Reviewed: a) PCI Project Instruction PI-CNSTR-OP-CAL-H-01, "Closure Welding of Holtec Multi-Purpose Canisters – UMAX," Revision 1; b) PCI Weld Control Procedure WCP-5, "Weld and Base Metal Repair," Revision 0

Category: Welding **Topic:** Weld Types for Canister Lid

Reference: FSAR 1032, Table 7.1.1 Revision 3

Requirement The canister closure welds on the canister lid shall be the following types: (a) canister lid to shell - partial penetration groove (b) vent and drain port cover plates - partial penetration groove (c) closure ring to shell - fillet (d) closure ring to closure ring radial - partial penetration groove (e) closure ring to lid - partial penetration groove.

Observation: PCI had procedures in place that insured all applicable welds listed in the Holtec HI-STORM FW FSAR Table 7.1.1 were accounted for. The types of canister closures welds used for the MPC were documented per the project instruction in Attachment 6, "PCI Energy Services Weld Process Traveler," and Attachment 7, "PCI Energy Services Multiple Weld Data Card." These attachments listed the weld types for each weld made in the process of final closure of the MPC.

Documents Reviewed: a) PCI Project Instruction PI-CNSTR-OP-CAL-H-01, "Closure Welding of Holtec Multi-Purpose Canisters – UMAX," Revision 1

Category: Welding **Topic:** Welder Performance Qualification Test

Reference: ASME Section IX, Part QW-301.2 Published 2007

Requirement The welder performance qualification test shall be welded in accordance with a qualified welding procedure specification (WPS), unless preheat or post weld heat treatment is specified.

Observation: NRC inspectors reviewed the Callaway procedure that provided instructions for qualifying welders, brazers, and brazing operators working under the Callaway's QA program. NRC inspectors also reviewed the welder performance qualification records (WPQs) and welding procedure specifications for the various welding procedures qualified for use during dry cask loading operations at Callaway. Each of the welders present during the welding dry run were qualified to perform the lid to shell, port caps covers, and final closure ring welding for the Holtec MPC. In addition, the qualifications of an additional welder who participated in the first loading campaign was also reviewed by the NRC inspectors.

Documents Reviewed: a) Callaway Procedure MTW-ZZ-WP002, "Welder Performance Qualification," Revision 27 b) PCI Welder Maintenance Logs (numerous); c) PCI ASME Section IX Welding Procedure Specifications for 8 MC-GTAW, Revision 15 and 8 MN-GTAW, Revision 4; d) PCI ASME IX Welding Procedure Qualification Records (numerous)

Category: Welding **Topic:** Welding Operator Performance Qualification

Reference: ASME Section IX, Parts QW-301.4, 361.2, 452.1, 6 Published 2007

Requirement The record of welding operator performance qualification (WOPQ) tests shall include the essential variables listed in QW-360, the type of test and test results, and the ranges qualified in accordance with QW-452. The essential variables for machine welding are: (1) welding process; (2) direct or remote visual control; (3) automatic arc voltage control (GTAW); (4) automatic joint tracking; (5) position qualified; (6) consumable inserts; (7) backing; and (8) single or multiple passes per side. Two side bend tests are required for groove weld test coupons 3/4 inch thick or greater. Groove weld tests qualify fillet welds.

Observation: NRC reviewed the welder performance qualification reports (WPQs) of several welders qualified to support dry cask storage operations at Callaway, including the welders who participated in the welding dry-run activities the week of May 18, 2015. All of the qualification records for welders explicitly addressed all eight essential variables noted in the requirement section, above. The welders performing the welding dry-run activities at Callaway were qualified in the eight essential variables. NRC inspectors also reviewed the performance qualification of an additional welder who participated in the initial loading campaign at Callaway who was not present during the welding dry-run.

Documents Reviewed: a) Numerous PCI Welder Performance Qualification records (WPQs)

Category: Welding **Topic:** Welding Procedure Specification (WPS)

Reference: ASME Section IX, Part QW-200.1 Published 2007

Requirement Each manufacturer or contractor shall prepare written Welding Procedure Specifications for making production welds to code requirements. Welding Procedure Specifications shall include the essential, non-essential, and (when required) supplementary essential variables for each welding process. The variables are listed in QW-250 through QW-280 and are defined in Article IV, Welding Data.

Observation: PCI, the welding contractor for Callaway, had prepared written Weld Procedure Specifications (WPS) 8-MC-GTAW and 8 MN-GTAW. Each WPS listed the proper essential, supplementary, and non-essential variables.

Documents Reviewed: a) PCI WPS 8-MC-GTAW, Revision 15; b) PCI WPS 8 MN-GTAW, Revision 3